



## ***2003 T&D OPERATING STUDY SOMERVILLE DISTRICT***

### **STATION #211 WOBURN**

Woburn Station #211 serves a power supply area consisting of the towns of Woburn, Arlington, Winchester and portions of Burlington, Lexington and Stoneham. In the summer of 2002 Woburn Station #211 peak load was 135MVA.

Woburn Station #211 consists of the following transformers:

Transformer #110A: Cooper Power Systems 24/32/40 MVA 117 kV to 14.4kV

Transformer #110B: Cooper Power Systems 24/32/40 MVA 117 kV to 14.4kV

Transformer #110C: North American 24/32/40 MVA 117 kV to 14.4kV

Transformer #110D: North American 24/32/40 MVA 117 kV to 14.4kV

Woburn #211 total capacity is 160 MVA. NSTAR employs summer emergency rating (cyclic capability) for each of these banks; Transformers 110A and 110B LTE ratings are 43.6 MVA and Transformers 110C and 110D LTE ratings are 40.1 MVA. Station #211's firm capacity is 123.8 MVA. Woburn Station #211 has approximately 14.9 MVA of RADSEC transfer switching to adjacent station of Burlington Station #391 and North Woburn Station #375. Woburn Station #211 has approximately 1.2 MVA of manual transfer switching to adjacent station of North Woburn Station #375. Woburn's load carrying capability is 140 MVA.

### **Overload Ratings:**

Transformer	Nameplate	12 hour LTE, 90F Ambient	12 hour LTE, 110F Ambient
110A	24/32/40 MVA	51 MVA	47 MVA
110B	24/32/40 MVA	51 MVA	47 MVA
110C	24/32/40 MVA	47 MVA	43 MVA
110D	24/32/40 MVA	47 MVA	43 MVA

### **Station Capabilities:**

Total Station Capacity (N)	Station Firm Capacity (LTE)	RADSEC Transfer	Manual Transfer	Total LCC
160 MVA	124 MVA	14.9 MVA	1.2 MVA	140.1 MVA

### **2004 – 2008 Projected Load**

2004	2005	2006	2007	2008
141 MVA	142 MVA	143 MVA	145 MVA	147 MVA

### **Switching Actions:**

Loss of Transformer #110A:

- Open:** Circuit Breakers #3 and #5 in Woburn 115kV Ring Bus  
Main 110A 13.8kV Circuit Breaker  
Disconnect Switch #T732
- Close:** ABR Scheme Closes 13.8kV Bus Tie Automatically  
Circuit Breakers #3 and #5 to restore Woburn 115kV Ring Bus

Loss of Transformer #110B:

- Open:** Circuit Breakers #4 and #6 in Woburn 115kV Ring Bus  
Main 110B 13.8kV Circuit Breaker  
Disconnect Switch #T733
- Close:** ABR Scheme Closes 13.8kV Bus Tie Automatically  
Circuit Breakers #4 and #6 to restore Woburn 115kV Ring Bus

Loss of Transformer #110C:

- Open:** Circuit Breakers #7 and #11 in Woburn 115kV Ring Bus  
Main 110C 13.8kV Circuit Breaker  
Disconnect Switch #T731
- Close:** ABR Scheme Closes 13.8kV Bus Tie Automatically  
Circuit Breakers #7 and #11 to restore Woburn 115kV Ring Bus

Loss of Transformer #110D:

- Open:** Circuit Breakers #15 and #16 in Woburn 115kV Ring Bus  
Main 110D 13.8kV Circuit Breaker  
Disconnect Switch #T734
- Close:** ABR Scheme Closes 13.8kV Bus Tie Automatically  
Circuit Breakers #15 and #16 to restore Woburn 115kV Ring Bus

For loss of either transformer, transfer of the following DSS lines via RADSEC switches may also be required:

Woburn 211-H7 to N. Woburn 375-H1 via RADSEC MRU on P 228/77 and RADSEC switch P228/72 for a transfer of 4.6 MVA

Woburn 211-H10 to Burlington 391-H11 via RADSEC MRU 193 on P 272/2 and RADSEC switch P 224/13 for a transfer of 3.4 MVA

Woburn 211-H13 to Burlington 391-H9 via RADSEC MRU 825 on P5/15 and RADSEC switch on P5/9 for a transfer of 1.8 MVA

Woburn 211-H6 to N. Woburn 375-H7 via RADSEC MRU on P53/15 and RADSEC switch on P 94/52 for transfer of 1.8 MVA

Woburn 211-H7 to N. Woburn 375-H2 via RADSEC MRU 825 on P221/7 and RADSEC switch on P 191/84 for a transfer of 1.7 MVA

Woburn 211-H12 to N. Woburn 375-H8 via RADSEC MRU 106 on P84/33 and RADSEC switch on P58/121 for a transfer of 1.6 MVA

Woburn 211-H1 to N. Woburn 375-H7 via Manual Switching for transfer of 1.2 MVA

**Summary of Concerns:**

1. Arlington and North Woburn line groups are overloaded under contingency conditions (2004)
2. 14 kV Distribution circuit 211-H1 heavily loaded approaching under normal conditions (2004)
3. 4 kV stations Woburn #211, Stoneham #301 and Woburn #325 are overloaded under contingency conditions (2004)
4. 4 kV lines 301-01, 301-03 (2004), 211-03, 211-08 and 211-09 (2008) overloaded under normal conditions

The Woburn Supply region is projected to experience modest load growth, approximately 1.1% annual load growth. As a result of this small load growth based on load projections, starting in the summer of 2004 for a single-contingency outage of any of the transformers, Woburn Station #211 will exceed the load carrying capability (1% over LTE, 1.4 MVA load risk). Between 2004-2008 there is the potential for 6 MVA of new load and the station could attain a loading of 107% of LCC. The load at risk would increase to 9.6 MVA.

**Distribution Systems****DSS Lines:**

Woburn Station #211 has two line groups the Arlington and North Woburn Line groups. In addition Woburn Station #211 has one of the two DSS lines of the Stoneham Line Group.

The **Arlington Line Group** consists of four DSS lines, 59-1471, 59-1383, 59-1384 and 59-1393H. The line group supplies NSTAR Stations #59 and #380 in Arlington. Line 59-1384 is normally closed at Station #380. Lines 59-1471 and 59-1383 are normally closed at Station #59. Upon the loss of any of the DSS lines, the remaining DSS lines will exceed the long-term emergency capacity (LTE), based on 2002 peak loads. The "Rebuild Arlington" project will help to alleviate these conditions.

The **North Woburn Group** consists of two DSS lines, 325-1388H and 325-1394H. The line group supplies NSTAR Station #325 in North Woburn. Distribution circuits are tapped off both DSS lines. Upon the loss of any of the DSS lines, the remaining DSS line will exceed the long-term emergency capacity (LTE), based on 2002 peak loads.

The **Stoneham Line Group** consists of two DSS lines 301-1386H and 301-1460. The line group is a loop supply between Woburn Station #211 and North Woburn Station #375. Line 301-1386H originates at Woburn Sta #211 and Line 301-1460 originates at North Woburn Sta #375. The line group supplies NSTAR Station #301 Elm and Central Streets, Stoneham and customer Station #242 Atlantic Gelatin, Woburn. Line 301-1386H also supplies primary metered customer at PMH15038. Upon the loss of any of the DSS lines, the remaining DSS lines will exceed the long-term emergency capacity (LTE), based on 2002 peak loads. The line 301-1386H will be relieved following the load split of the Line Group at Station #342 (Atlantic Gelatin). This mitigation action will address the overload condition on the line group.

DSS Line	% of Normal 2004	LTE - % Load at Risk 2004	MVA at Risk 2004	LTE - % Load at Risk 2008	MVA at Risk 2008
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59-1471	<b>105%</b>	<b>61%</b>	<b>7.4</b>	<b>67%</b>	<b>8.4</b>
59-1383	77%	<b>61%</b>	<b>3.9</b>	<b>67%</b>	<b>4.5</b>
59-1384	<b>107%</b>	<b>51%</b>	<b>4.0</b>	<b>56%</b>	<b>4.6</b>
58-1393H	77%	0%	0	0%/0	0
325-1388H	72%	<b>16%</b>	<b>0.8</b>	<b>24%</b>	<b>1.2</b>
325-1394H	<b>100%</b>	<b>51%</b>	<b>3.5</b>	<b>54%</b>	<b>3.9</b>
301-1386H	85%	0%/0	0	0%	0

Loading on Woburn #211 DSS lines.

#### 14 kV Distribution Circuits:

The twelve distribution circuits fed from Woburn #211 will have adequate capacity. In 2004 one circuit 211-H1 is projected to exceed normal capacity with all lines in service. This heavy loading condition will be address by load transfers to adjacent Woburn distribution circuits. In addition, 211-H5, 211-H7, 211-H11, 211-H12 and 211-08 were identified as poor performing circuits in the system.

<b>14 kV Radial Line</b>	<b>% of Normal 2002</b>	<b>Projected % of Normal 2004</b>	<b>Projected % of Normal 2008</b>
211-H1	98%	<b>101%</b>	<b>105%</b>
211-H2	70%	72%	75%
211-H3	80%	82%	82%
211-H4	41%	42%	44%
211-H5	51%	52%	54%
211-H6	76%	78%	82%
211-H7	70%	72%	75%
211-H8	88%	90%	93%
211-H10	49%	50%	52%
211-H11	33%	34%	36%
211-H12	56%	57%	59%
211-H13	90%	92%	96%
211-H14	69%	70%	73%

Loading on Woburn #211 14 kV distribution circuits.

#### 4kV Distribution Stations

Woburn #211 supplies five 4kV stations: Arlington #59 (Mystic Street), Woburn #211 (Cove Street), Woburn #325 (Main Street), Lexington #351 (Lilian Road) and Arlington #380 (88 Mystic Street).

<b>4 kV Station</b>	<b>2002 Peak (MVA)</b>	<b>LTE Capacity (MVA)</b>	<b>2004 Projection (MVA)</b>	<b>2008 Projection (MVA)</b>
Arlington #59	10.9	16.5	7.1	7.4
Woburn #211	<b>16.9</b>	13.5	<b>14.4</b>	<b>14.9</b>
Woburn #325	<b>6.3</b>	6.0	<b>6.4</b>	<b>6.7</b>
Lexington #351	9.6	12.0	5.9	6.1

Arlington #380

7.2

8.0

Retired

Retired

Loading on 4 kV distribution stations fed from Woburn #211

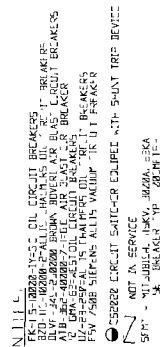
The Woburn #211 4kV Station has three 4 kV circuits, 211-03, 211-08 and 211-09, that by 2008 will be heavily loaded and exceed normal capacity with all lines in service.

### Proposed Integrated Plan:

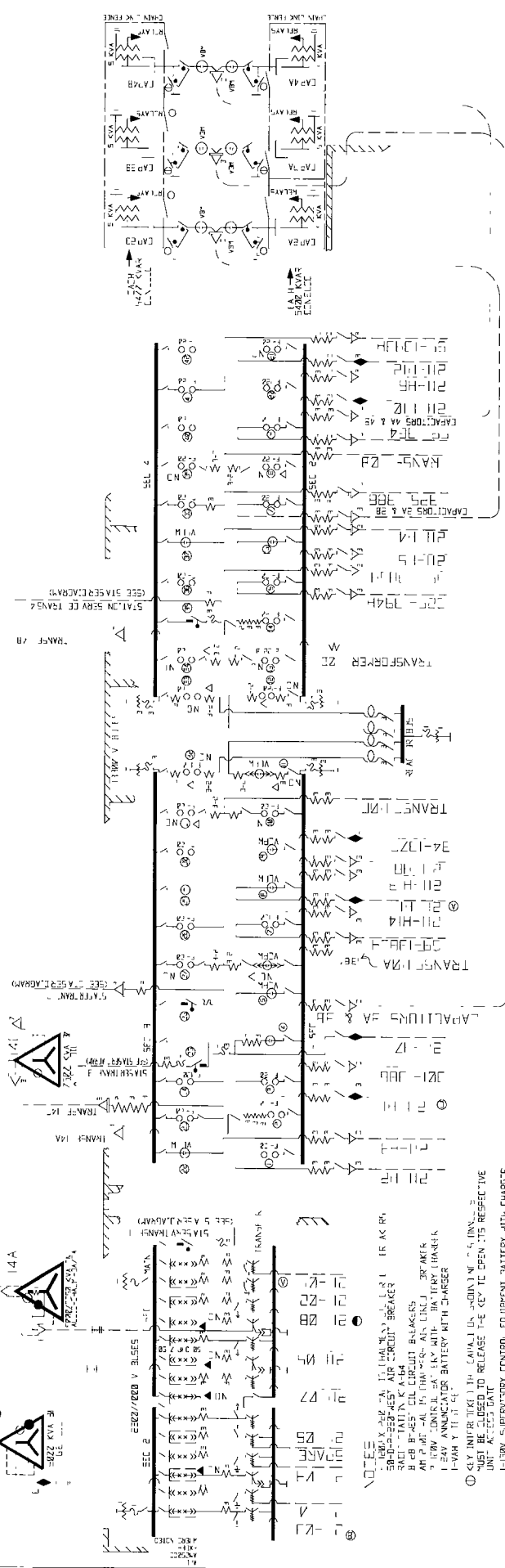
The suggested actions in the table will address the concerns within the Woburn supply region. The proposed integrated plan will address the heavy loading conditions, the voltage regulation and the short circuit concerns of Woburn Station #211. The primary focus of the plan will be to use a portion of the increased transformer capacity at North Woburn Station #375 to relieve Woburn Sta #211. Install two new 13.8 kV distribution circuits and transfer 10-12 MVA of load from Woburn Sta #21 to North Woburn Sta #375. Subsequent to this load relief the existing Woburn 14kV distribution circuits will be used to support the continued conversion of the 4 kV system. Upgrade 211-H9 and 211-H13 and relieve the Arlington Line Group. The continued strategic conversions of portions of 4 kV circuits will reduce the projected overloads on the 4kV distribution circuits supplied by Stoneham Sta #301 and Woburn Sta #325.

Action	Year needed	Cost
⇒ Install 2 North Woburn Sta #375 distribution circuits to relieve Woburn Station #211 of 10-12 MVA load relief and support conversion of Woburn Sta #211 4kV circuits to 13.8 kV circuits.	2004-2007	\$4.25 M
⇒ Upgrade 211-H9 and 211-H3 to assist in relieving Arlington Line Group	2004-2005	\$2.0 M
⇒ Convert Woburn #325, Stoneham #301 and install 1 MW GE Mobile Generators at each of these 4 kV stations (\$150K/year per generator Expense)	2005	\$150K

*Recommended course of action for Woburn Region*



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## ***2003 T&D OPERATING STUDY SOMERVILLE DISTRICT***

### **STATION #250 MYSTIC**

Mystic Station #250 serves a power supply area consisting of the city of Somerville, the Charlestown section and portions of the North End section of the city of Boston. In the summer of 2002 the peak load at Mystic Station #250 was 180 MVA.

Mystic Station #250 consists of the following transformers:

Transformer #110A: Hyundai 37/50/62.5 MVA 117 kV to 14.4kV

Transformer #110B: Hyundai 37/50/62.5 MVA 117 kV to 14.4 kV

Transformer #110C: General Electric 92 / 60 / 92 MVA 110 kV to 24 /18 kV\*

Transformer #110D: General Electric 92 / 60 / 92 MVA 110 kV to 24 /18 kV\*

Transformer #24A: Westinghouse 25/33 MVA 24 kV to 13.8 kV

Transformer #24B: General Electric 25/33 MVA 24 kV to 13.8 kV

Transformer #24C: General Electric 75MVA 24kV to 13.8 kV/13.8 kV

\*18kV winding is for Sithe Unit #4 Output, for which 92 MVA limit applies. 24kV winding is NSTAR load winding, for which 60 MVA limit applies.

Mystic Station #250 total capacity is 245 MVA. NSTAR employs summer emergency rating (cyclic capability) of 66 MVA for each of the new Hyundai two banks and 67.2MVA for each of the 24 kV winding of the Transformers 110C and 110D. Station #250's firm capacity is 199.2. MVA. Mystic Station #250 has very modest manual transfer switching via Beacon Street Station #14 to Chelsea #488. Mystic's load carrying capability is 203 MVA.

### **Overload Ratings:**

Transformer	Nameplate	12 hour LTE, 90F Ambient	12 hour LTE, 110F Ambient
110A	37/50/62.5 MVA	81 MVA	70.7MVA
110B	37/50/62.5 MVA	81 MVA	70.7MVA
110C	60 MVA	80 MVA	73 MVA
110D	60 MVA	80 MVA	73 MVA

### **Station Capabilities:**

Total Station Capacity (N)	Station Firm Capacity (LTE)	RADSEC Transfer	Manual Transfer	Total LCC
245 MVA	199 MVA	0 MVA	4 MVA	203 MVA

### **2004 – 2008 Projected Load**

2004	2005	2006	2007	2008
185 MVA	186 MVA	187 MVA	190 MVA	193 MVA

### **Switching Actions:**

#### **Loss of Transformer #110A:**

- Open:** Circuit Breakers #15 and #17 in Mystic 115kV Ring Bus  
Main 110A 13.8kV Circuit Breaker on Section 1-2 Reactor Bus  
Disconnect Switch #T738
- Close:** 13.8 kV bus-tie breakers operated normally closed.  
Manually close Circuit Breakers #15 and #17 to restore Mystic 115kV Ring Bus

#### **Loss of Transformer #110B:**

- Open:** Circuit Breakers #2 and #3 in Mystic 115kv ring bus  
Circuit Switcher #CS770  
Main 110B 13.8kV Circuit Breaker on Section 3 Reactor Bus
- Close:** 13.8 kV bus-tie breakers operated normally closed.  
Manually close Circuit Breakers #2 and #3 to restore Mystic 115kv Ring Bus

#### **Loss of Transformer #110C:**

- Open:** Circuit Breakers #1 and #2 in Mystic 115kV Ring Bus  
Main 110C 24kV circuit breaker on Section 2 24kV Mystic bus  
Main 110C 18kV switch at Site Unit #4 Section #1
- Close:** 24 kV bus-tie breakers operated normally closed.  
Circuit Breakers #1 and #2 in Mystic 115kV Ring Bus

#### **Loss of Transformer #110D:**

- Open:** Circuit Breakers #4 and #5 in Mystic 115kV Ring Bus  
Main 110C 24kV circuit breaker on Section 1 24kV Mystic bus  
Main 110C 18kV switch at Site Unit #4 Section #2
- Close:** 24 kV bus-tie breakers operated normally closed.  
Circuit Breakers #4 and #5 in Mystic 115kV Ring Bus

### **Summary of Concerns:**

1. Mystic Station #250 heavily loaded; Transformer firm capacity is at 97%(2008).
2. Somerville Network line group overloaded under contingency conditions (2004)
3. 14 kV Distribution circuits 10-H2 and 250-H1 (2008) are overloaded under normal conditions.
4. 4 KV Supply: Salem Street, Boston (Sta #30) at 104% (2004), Somerville Primary Network at 103% (2008) and 17-N33 is overloaded at PNU17 (2008).

Without any significant major development projects during 2002-2008, the Mystic Supply region is projected to experience meager load growth; approximately 1.1% annual load growth. As a result of

this small load growth based on the existing load forecast, the upgraded Mystic Station #250 with the new Hyundai transformers will support the forecasted load growth in the Station #250 supply region through 2008. During the summer of 2008 for a single-contingency outage of either transformer 110C or 110D, Mystic Station #250 will be less than the load carrying capability (95% of LCC).

### **Distribution Systems:**

#### **DSS Lines:**

Mystic Station #250 has three line groups the Charlestown, North End and Somerville line groups. In addition Mystic Station #250 has two of the four DSS lines of the Sumner/Callahan Tunnel Line Group.

The **Charlestown Line Group** consists of DSS lines 10-178, 15-188 and distribution circuit 250-H5. The line group supplies NSTAR Charlestown Stations #10 and #15. Stations #10 and 15 are connected by two loops of two DSS lines each (530-178,10-178, 471-203 and 6-203). During the spring 2003 both 10-178 and 15-188 were reconductored. Upon the loss of either DSS line, the remaining DSS line will not exceed the long-term emergency capacity (LTE), based on 2002 peak loads.

The **North End Line Group** consists of DSS lines 30-179H and 225-184. The line group supplies NSTAR Station #30 Salem Street, within the North End section of Boston and customer stations #195, 225 (Fleet Center), 539,545 and 572. Line 30-179H is tapped to supply distribution circuit 30-179H1 and PMH16031. Upon the loss of either DSS line, the remaining DSS line will not exceed the long-term emergency capacity (LTE), based on 2002 peak loads.

The **Somerville Line Group** consists of 6 DSS lines: 250-1N33H, 250-1N35H, 250-1N38H, 250-1N39H, 250-1N81H and 250-1N90H. The line group supplies the six (6) Somerville Primary Network Units (PNUs) and the customer stations #480, 557,596, SC10, SC26 and SC35. Lines 250-1N33H, 250-1N35H, 250-1N38H, 250-1N81H and 250-1N90H are tapped to supply distribution circuits. During the spring 2003 250-1N33H was reconductored. Upon the loss of any DSS line one or more of the remaining DSS lines exceed the long-term emergency capacity (LTE), based on 2002 peak loads.

The **Sumner/Callahan Tunnel Line Group** consists of four DSS lines 224-87H, 262-53H, 218-80H and 218-188. The DSS lines 218-80H and 218-188 originate from Mystic Sta #250 and supply NSTAR Salem Street Station #30 in the North End section of the city of Boston and customer stations 218, 393, 539, 6, 572, 599 and 545 in Boston. DSS lines 224-87H and 262-53 H originate from Chelsea Sta #488 and supplies customer stations 224, 262, 394, 542 and MC 7,8,12 and PMH15005 in East Boston. The Chelsea lines 224-87H and 262-53H are part of a two-line supply and support each other. The two Boston lines 218-80H and 218-188 are part of a two-line supply and support each other. A looped line thru the Callahan Tunnel via Stations 393 and #394 connects the Boston and Chelsea lines. Upon the loss of any of the DSS lines, the remaining DSS lines will not exceed the long-term emergency capacity (LTE), based on 2002 peak loads.

<b>DSS Line</b>	<b>% of Normal 2004</b>	<b>LTE - % Load at Risk 2004</b>	<b>MVA at Risk 2004</b>	<b>LTE - % Load at Risk 2008</b>	<b>MVA at Risk 2008</b>
10-178	85%	0%	0	0%	0
15-188	70%	0%	0	0%	0
30-179	80%	0%	0	0%	0

225-184	65%	0%	0	0%	0
250-1N33H	90%	20%	1.5	28%	2.3
250-1N35H	75%	24%	2.0	30%	2.6
250-1N38H	30%	3%	0.1	20%	0.7
250-1N39H	85%	4%	0.3	12%	0.9
250-1N81H	120%	0%	0	45%	0.6
250-1N90H	90%	44%	4.7	53%	5.9
218-80H	55%	0%	0	0%	0
218-188	55%	0%	0	0%	0

Loading on Mystic#250 DSS lines.

### Distribution Circuits:

Six distribution circuits fed from Mystic #250 will have adequate capacity. By 2008 two circuits 10-H2 and 250-H1 are projected to exceed normal capacity with all lines in service. In addition, 250-H6 was identified as poor performing circuits in the system.

14 kV Radial Line	% of Normal 2002	Projected % of Normal 2004	Projected % of Normal 2008
10-H1	74%	76%	80%
10-H2	94%	97%	101%
250-H1	94%	97%	101%
250-H2	85%	87%	91%
250-H3	74%	76%	79%
250-H4XY	51%	53%	53%
250-H5	87%	89%	92%
250-H6	82%	84%	87%

Loading on the Mystic Distribution Circuits.

Mystic #250 supplies Somerville Primary Network and one 4kV station: Salem Street Station #30 (North End).

At Salem Street Sta #30 the loss of the 6.25 MVA transformer, the remaining two 1.5 MVA transformers will exceed the long-term emergency capacity. There is 0.3 MVA load at risk for this event.

Ongoing load conversions have slightly reduced and will continue to decrease the loading of the Somerville Primary Network. During 204-2008 the Somerville Network is expected to have only meager load growth, by 2008 the loss of one the transformers within the Somerville network will strain the infrastructure. The projected load will exceed the capability of the network by less than 1 MVA.

4 kV Station & Region	2002 Peak (MVA)	LTE Capacity (MVA)	2004 Projection (MVA)	2008 Projection (MVA)
Somerville Network	29.9	28.8	28.6	29.7
North End #30	3.3	3.3	3.4	3.6

## Loading on 4 kV station and region fed from Mystic #250

**Proposed Integrated Plan:**

The suggested actions in the table will address the concerns within the Mystic supply region. Mystic Station #250 has adequate transformer capacity to support the projected meager load growth beyond 2008. Mystic Station #250 reconductor several of the feeder sections of the DSS Lines within the Somerville Network Line Group. Reconfigure the Somerville Network Line Group and install two new DSS lines to relieve line group. Reconductor the feeder sections of distribution circuits 10-H2 and 250-H1. The continued strategic conversions of portions of 4 kV circuits will reduce the projected overloads on the 4kV distribution circuits supplied by Somerville Line Group.

<b>Action</b>	<b>Year needed</b>	<b>Cost</b>
⇒ Distribution infrastructure upgrades, including reconductor feeder section of the Mystic Station #250 lines and circuits	2004	\$300k
⇒ Install new Somerville #402 DSS lines to supply Somerville Network or relieve line group by load transfer to adjacent distribution circuits	2005	TBD



TYPE	DATE	TIME	LOCATION	REMARKS
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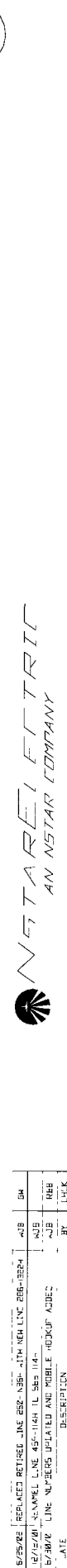
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STATIONING STATION 200 - 76 ADDED 50, 250  
1867, 1867, 200, 1867 & 2450 200, 250

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## ***2003 T&D OPERATING STUDY SOMERVILLE DISTRICT***

### **STATION #375 N. WOBURN (DRAGON COURT)**

North Woburn Station #375 serves a power supply area consisting of portions of the towns of Woburn and Stoneham. In the summer of 2002 N. Woburn Station #375 peak load was 90 MVA.

North Woburn Station #375 consists of three 115/13.8 kV step-down transformers:

Transformer #110A: Westinghouse 50 MVA 108.9kV to 13.8kV

Transformer #110B: Westinghouse 50 MVA 108.9kV to 13.8kV

Transformer #110C: ABB 37/50/62.5 MVA 117 kV to 14.4 kV

NSTAR employs summer emergency rating (cyclic capability) for these three banks. Transformers 110A and 110B have a summer emergency rating (cyclic capability) of 62.5 MVA each. Transformer 110C has a summer emergency rating of 73.7 MVA. Station's #375 has a total capacity of 162.5 MVA. Due to impedance difference between the transformers will need to balance the bus section loading to maximize the use of the transformer capacity. Station #375's firm capacity is limited to 100 MVA. There is approximately 9.0 MVA of RADSEC transfer switching capability to adjacent Woburn Station #211. North Woburn's load carrying capability is 109 MVA.

### **Overload Ratings:**

Transformer	Nameplate	12 hour LTE, 90F Ambient	12 hour LTE, 110F Ambient
110A	50 MVA	68 MVA	63 MVA
110B	50 MVA	68 MVA	63 MVA
110C	62.5 MVA	80.7 MVA	73.7 MVA

### **Station Capabilities:**

Total Station Capacity (N)	Station Firm Capacity (LTE)	RADSEC Transfer	Manual Transfer	Total LCC
163 MVA	100 MVA*	9.0 MVA	0.0	109 MVA

\* Based upon loss of either 110A/211-504, or loss of 110B/211-503 or loss of 110C.

### **2004 – 2008 Projected Load**

2004	2005	2006	2007	2008
98 MVA	101 MVA	103 MVA	104 MVA	106 MVA

### **Switching Actions:**

Loss of Transformer #110A and 211-504/N140 Line:

- Open:** OCB 2 & 4 @ Woburn #211  
OCB 1 & 2 @ Reading (Municipal)  
OCB 40 & 40-45 @ Tewksbury (NGRID)  
Circuit Switcher #CS770  
Main 110A 13.8kV Circuit Breaker
- Close:** ABR scheme closes the 13.8kV tie breakers @ North Woburn Station #375  
Manually close OCB's 2 & 4 @ Woburn  
Manually close OCB's 1 & 2 @ Reading (Municipal)  
Manually close OCB's 40 & 40-45 @ Tewksbury (NGRID)

Loss of Transformer #110B and 211-503/M139 line:

- Open:** OCB's 1 & 3 @ Woburn  
OCB's 4 & 5 @ Reading (Municipal)  
OCB's 39 & 39-46 @ Tewksbury (NGRID)  
GCB #1 @ North Woburn Sta #375  
Circuit Switcher #CS771  
Main 110B 13.8kV Circuit Breaker
- Close:** ABR scheme closes GCB 4 and the 13.8kV tie breakers @ North Woburn Station #375  
Manually close OCB's 1 & 3 @ Woburn  
Manually close OCB's 4 & 5 @ Reading (Municipal)  
Manually close OCB's 39 & 39-46 @ Tewksbury (NGRID)

Loss of Transformer #110C

- Open:** GCB #1 @ North Woburn Sta #375  
Main 110C 13.8kV Circuit Breaker
- Close:** ABR scheme closes 13.8kV tie breakers @ North Woburn Station #375

For loss of either transformer, transfer of the following DSS lines via RADSEC switches may also be required:

N. Woburn 375-H1 to Woburn 211-H7 via RADSEC MRU's 052 & 021 for a transfer of 3.9 MVA  
N. Woburn 375-H8 to Woburn 211-H12 via RADSEC MRU's 106 & 891 for a transfer of 0.7 MVA  
N. Woburn 375-H6 to Woburn 325-1394H via RADSEC MRU's 808 & 423 for a transfer of 0.2 MVA  
N. Woburn 375-H3 to Woburn 211-H5 via RADSEC MRU's 026 & 045 for a transfer of 0.8 MVA  
N. Woburn 375-H7 to Woburn 211-H6 via RADSEC MRU 230 and manual switch on P57/21 for a transfer of 3.0 MVA

Total Transfer: 8.5 MVA

**Summary of Concerns:**

1. North Woburn line group overloaded under contingency conditions (2004)
2. 14 kV Distribution circuits 375-H6 (2005), 375-H3 (2006), 375-H7 (2007) and 375-H8 (2008) heavily loaded approaching under normal conditions

Without any significant major development projects during 2002-2008, the North Woburn Supply region is projected to experience load growth; approximately 2.8% annual load growth. As a result of this modest load growth based on load projections, by the summer of 2008 for a single-contingency outage of either transformers 110A/ 110B or transformer 110C, North Woburn Station #375 will be at 99% of the load carrying capability.

### **Distribution Systems:**

#### **DSS Lines:**

North Woburn Station #375 has one of the two DSS lines of the Stoneham Line Group.

The **Stoneham Line Group** consists of two DSS lines 301-1386H and 301-1460. The line group is a loop supply between North Woburn Station #375 and Woburn Station #211. Line 301-1460 originates at North Woburn Sta #375 and Line 301-1386H originates at Woburn Sta #211. The line group supplies NSTAR Station #301 Elm and Central Streets, Stoneham and customer Station #242 Atlantic Gelatin, Woburn. Line 301-1386H also supplies primary metered customer at PMH15038. Upon the loss of any of the DSS lines, the remaining DSS lines will exceed the long-term emergency capacity (LTE), based on 2002 peak loads. The line 301-1386H will be relieved following the load split of the Line Group at Station #342 (Atlantic Gelatin). This mitigation action will address the overload condition on the line group.

<b>DSS Line</b>	<b>% of Normal 2004</b>	<b>LTE - % Load at Risk 2004</b>	<b>MVA at Risk 2004</b>	<b>LTE - % Load at Risk 2008</b>	<b>MVA at Risk 2008</b>
301-1460	37%	0%	0	0%	0

Loading on North Woburn #375 DSS line.

#### **14 kV Distribution Circuits**

The eleven distribution circuits fed from North Woburn #375 have adequate capacity. Starting in 2005 and continuing through 2008 several distribution circuits will be heavily loaded reached between 90% and 99% of its normal capacity with all lines in service; 375-H2, 375-H3, 375-H7 and 375-H8. The 2003 North Woburn Station #375 upgrade which included the installation of a new section of distribution switchgear, will provide feeder positions to support new distribution circuits to relieve the heavy loading conditions on the North Woburn #375 distribution circuits. In addition, 375-H2, 375-H6 and 375-H8 are a poor performers.

<b>14 kV Radial Line</b>	<b>% of Normal 2002</b>	<b>Projected % of Normal 2004</b>	<b>Projected % of Normal 2008</b>
375-H1	70%	75%	83%
375-H2	83%	87%	94%
375-H3	88%	92%	99%
375-H4	76%	76%	84%
375-H5	72%	23%	31%
375-H6	88%	80%	89%
375-H7	86%	90%	98%
375-H8	85%	89%	97%
375-H9	77%	77%	85%

375-H10	New	23%	26%
375-H11	New	63%	68%

Loading on North Woburn Station #375 Distribution Circuits.

North Woburn Station #375 does not supply any 4 kV stations.

**Proposed Integrated Plan:**

The suggested actions in the table will address the concerns within the North Woburn supply region. The primary focus of the plan will be to use a portion of the increased transformer capacity and new section of distribution switchgear at North Woburn Station #375 to relieve Woburn Sta #211. The new distribution switchgear will provide spare feeder positions for new circuits that would relieve the heavily loaded 14 kV distribution circuits and to increased transfer switching between Woburn, and Burlington stations. Install two new 13.8 kV distribution circuits and transfer 10-12 MVA of load from Woburn Sta #211 to North Woburn Sta #375. Installing the new transformer at North Woburn augmented by additional RADSEC switches will provide the foundation for all the North Woburn area capacity needs beyond 2008.

Action	Year needed	Cost
Install ASU switches to increase North Woburn transfer switching by 15 MVA	2005	\$360K
Install 2 North Woburn Sta #375 distribution circuits to relieve Woburn Station #211 of 10-12 MVA load relief and support conversion of Woburn Sta #211 4kV circuits to 13.8 kV circuits	2004-2007	\$4.25 Million



# ***2003 T&D OPERATING STUDY SOMERVILLE DISTRICT***

## **STATION #402 SOMERVILLE**

Somerville Station #402 serves a power supply area consisting of a portion the city of Somerville from Willow Avenue Station #16, and Imman Square section of the city of Cambridge.

Somerville Station #402 consists of the following transformers:

Transformer #110A: Westinghouse 50/56 MVA 115 kV to 13.8kV

Transformer #110B: Westinghouse 50/56 MVA 115 kV to 13.8kV

Somerville Station #402 total capacity is 112 MVA. NSTAR employs summer emergency rating (cyclic capability) of 65 MVA for each of the transformer banks. Station #402's firm capacity is 65. MVA. Somerville Station #402 has no transfer switching adjacent stations. Somerville's load carrying capability is 65 MVA.

The interconnection between Cambridge Electric Company and Somerville Station #402 is subject to a 1960's contract between Cambridge Electric Light Company and Boston Edison Company. The specifics of this contract were amended in 1983. The contract states, with both Somerville Station #402 transformers in service, of the 90MVA of available capacity Cambridge Electric (Prospect Street #819) is allowed up to 80 MVA, while Boston Edison (Somerville Station #402) has 10MVA. If Somerville Station #402 load is greater than 75 MVA, for the loss of one (1) transformer the contract requires Cambridge Electric to reduce its load down to 65MVA within fifteen (15) minutes and down to 46 MVA within two (2) hours. If the Somerville Station #402 load is between 62.5 and 75MVA Cambridge Electric needs to reduce its load to 46MVA within four (4) hours of the loss of a transformer. Cambridge Electric has fulfilled the obligations of the contract by dispatching additional Kendall generation as operating conditions dictate.

## **Overload Ratings:**

Transformer	Nameplate	12 hour LTE, 90F Ambient	12 hour LTE, 110F Ambient
110A	50/56 MVA	69 MVA	65 MVA
110B	50/56 MVA	69 MVA	65MVA

## **Station Capabilities:**

Total Station Capacity (N)	Station Firm Capacity (LTI:)	RADSEC Transfer	Manual Transfer	Total LCC
112 MVA	84 MVA (A)	0 MVA	0 MVA	84 MVA

(A) Includes 19 MW of Kendall generation.

### **2004 – 2008 Projected Load**

2004	2005	2006	2007	2008
78 MVA	79 MVA	79 MVA	81 MVA	82 MVA

### **Switching Actions:**

#### **Loss of Transformer #110A and 329-511 Line:**

- Open:** OCB's 5 & 6 @ Mystic  
OCB's 7 & 8 @ Brighton  
Circuit Switcher #CS770  
Main 110A 13.8kV Secondary Circuit Breaker
- Close:** 13.8kV Tie Breakers Operated Normally Closed  
Manually close OCB's 5 & 6 @ Mystic  
Manually close OCB's 7 & 8 @ Brighton

#### **Loss of Transformer #110B and 329-510 Line:**

- Open:** OCB's 12 & 13 @ Mystic  
OCB's 4 & 5 @ Brighton  
Circuit Switcher #CS771  
Main 110B 13.8kV Secondary Circuit Breaker
- Close:** 13.8kV Tie Breakers Operated Normally Closed  
Manually close OCB's 12 & 13 @ Mystic  
Manually close OCB's 4 & 5 @ Brighton

No 13.8kV Distribution Circuit Transfers at this station.

Without any significant major development projects during 2002-2008 the Somerville Station #402 supply region is projected to experience meager load growth; approximately 1.2% annual load growth. As a result of this small load growth based on the existing load forecast, the Somerville Station #402 supported by local generation is capable to supply the forecasted load growth in the Station #402 supply region through 2008.

### **Distribution**

#### **4 kV Stations**

Somerville #402 supplies one 4kV station Willow Avenue Station #16. Upon the loss of one of its two 9.375 MVA transformers, the remaining transformer will not exceed its long-term emergency capacity. There is no load at risk in this event.

4 kV	2002	LTE	2004	2008
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Station		Peak (MVA)	Capacity (MVA)	Projection (MVA)	Projection (MVA)
Willow	Street	8.5	11.25	8.7	9.1
#16					

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**Loading on 4 kV station fed from Somerville #402**

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**Proposed Integrated Plan:**

The new East Cambridge at Mirant Substation with a final completion date of June 2005 will have an impact on the substation and distribution capacity in both the Somerville and Prospect Street supply areas. The new East Cambridge station will be developed to provide expanded distribution and substation capacity to supply the East Cambridge and Kendall Square loads within City of Cambridge. The East Cambridge station will install distribution infrastructure to supply the local load growth and is available under contingency conditions to support the Prospect Street supply region, presently supplied by Somerville Station #402. Based on 2004-2008 load projections with the development of the East Cambridge at Mirant station there are no additional actions required to supply the increased customer load within the Somerville and Prospect Street supply regions during the 2004-2008 time period.





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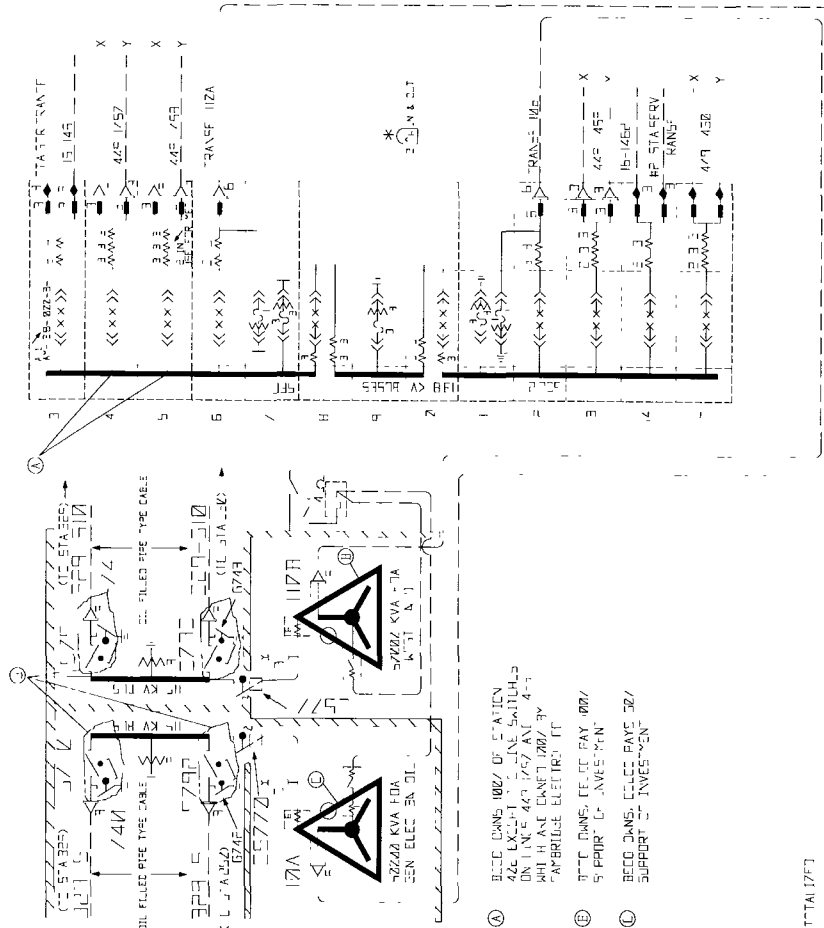
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## ***2003 T&D OPERATING STUDY SOMERVILLE DISTRICT***

### **STATION #488 CHELSEA**

The Chelsea and East Boston communities within the NSTAR electrical service territory are supplied by Chelsea Station #488 (115/14 kV) and Chelsea Station #445 (24/14 kV). Chelsea Station #488 supplies Logan Airport Station #308 and #592, plus additional customer stations and distributions circuits in East Boston and Chelsea. Station #445 supplies Logan Airport Station #486 and other distribution load within the region.

Chelsea Station #488 consists of three 115/13.8 kV step-down transformers:

Transformer #110A: General Electric 30/40 [44.8] MVA 110kV to 13.8kV

Transformer #110B: General Electric 30/40 [44.8] MVA 110kV to 13.8kV

Transformer #110C: Westinghouse 18/24 MVA 110 kV to 13.8kV\*

\*No nameplate data available, information obtained from station one line diagram.

Chelsea Station #488 total capacity is 104 MVA. NSTAR employs summer emergency rating (cyclic capability) of 52 MVA for transformer banks 110A and 110B. Transformer 110C supplies bus section #2 of Station #445. Transformer 110C has a summer emergency rating (cyclic capability) of 26 MVA. Station #488's firm capacity is 78 MVA.

**Chelsea Station #445** consists on a single 24/14 kV step-down transformer supplied by a dedicated Mystic-Chelsea 24 kV line 445-2136.

**Transformer #24A: General Electric 15/20 MVA 24 / 13.8kV**

Transformer 24A which supplies bus section #1 of Station #445 has a summer emergency rating (cyclic capability) of 22 MVA.

At Chelsea Sta #488, the different impedance between transformers 110A and 110B and 110C present a very significant challenge to use all the potential available transformation within the Chelsea – East Boston. The firm capacity provided by the two NSTAR stations is 82 MVA. There is minimal manual transfer switching capability to Mystic station, is approximately 4 MVA. Chelsea-East Boston region's load carrying capability (i.e. firm capacity + transfer switching) is 86.0 MVA.

### **Station #488 Overload Ratings:**

Transformer	Nameplate	12 hour LTE, 90F Ambient	12 hour LTE, 110F Ambient
110A	30/40 [44.8] MVA	57 MVA	52 MVA

110B	30/40 [44.8] MVA	57 MVA	52 MVA
110C	18/24 MVA	29 MVA	26 MVA

### **Station #445 and #488 Capabilities:**

Total Station Capacity (N)	Station Firm Capacity (LTE)	RADSEC Transfer	Manual Transfer	Total LCC
124 MVA	82 MVA	0 MVA	4.6 MVA	86.6 MVA

### **Chelsea and East Boston** **2004 – 2008 Projected Load**

2004	2005	2006	2007	2008
94 MVA	96 MVA	99 MVA	102 MVA	104 MVA

### **Switching Actions @ Sta #488:**

#### Loss of Transformer #110A and 128-518/P168 Line:

- Open:** OCB 68-79 @ Revere (NGRID)  
           OCB #1  
           Circuit Switcher #CS771  
           Main 110A 13.8kV Secondary Circuit Breaker
- Close:** 13.8kV Tie Breakers Operated Normally Closed  
           Manually close OCB 68-79 @ Revere (NGRID)  
           Manually close OCB #1 to restore 115 kv tie line.

#### Loss of Transformer #110B and 488-518 Line:

- Open:** GCB's 23 & 24 @ Mystic  
           OCB #2  
           Circuit Switcher #CS770  
           Main 110B 13.8kV Secondary Circuit Breaker
- Close:** 13.8kV Tie Breakers Operated Normally Closed  
           Manually close GCB's 23 & 24 @ Mystic  
           Manually close OCB #2 to restore 115 kv tie line.

#### Loss of Transformer #110C:

- Open:** OCB's 1 & 2  
           Circuit Switcher #CS772  
           Main 110C 13.8kV Circuit Breaker
- Close:** Nothing at Station 488 – Transformer Feeds Station 455 (Crescent Avenue)  
           Manually close OCB's 1 & 2

The tie lines 445-1210 and 445-1211 will close upon the loss of a transformer at either Station #488 or #445.

For loss of either transformer, transfer of the following DSS lines via manual switches may also be required:

Chelsea 488-H1 to 14-99XYH Mystic via manual switches PMH3212 and PMH3209 for a peak transfer of 1.9 MVA.

Chelsea 488-H1 to 108-195H Mystic via manual switches PMH4924 and PMH4926 for a peak transfer of 2.7 MVA.

Total Transfer: 4.6 MVA

**Summary of Concerns:**

1. Inadequate transformer capacity (2004)
2. Logan West and Logan East line groups overloaded under contingency conditions (2004)
3. 14 kV Distribution circuits 445-H4 (2004), 445-H2 (2006), 488-H1 (2007) and 488-H2 (2008) are overloaded under normal conditions.

Massport- Logan Airport is the largest NSTAR customer within the Chelsea- East Boston region. Logan Airport continues to modernize and expand their facilities. Logan Airport has completed the construction of a new Chiller Plant and nearing completion of their new Terminal A. These projects will add more 6 MVA of load by the summer, 2004. The future growth at Logan including the new Terminal B is most likely dependent on the economy. It is anticipated that the proposed Logan expansion will add potentially 10 MVA of new load prior to the Summer 2006. The new Logan load in combination with the modest load growth within the remainder of the Chelsea-East Boston supply area will strain the capability of Chelsea #445 and #488 substation and distribution infrastructure to support the customer load requirements. As a result of this significant load growth at Logan Airport and throughout the supply region based on load projections, starting in the summer of 2004 for a single-contingency outage of either transformers 110A or 110B, at Chelsea Sta #488 Chelsea-East Boston region will exceed the load carrying capability (9% over LTE, 7.4 MVA load risk). Between 2004-2008 there is the potential for 10 MVA of new load and the Chelsea-East Boston region could attain a loading of 120% of LCC. The load at risk would increase to 17.4 MVA.

Install and place into service a mobile 115/14kV transformer within 24 hours of a failure of one of the Chelsea Station #488 transformers.

**Distribution Systems:**

**DSS Lines:**

Chelsea Stations #445 and #488 has two line groups the Logan East and Logan West line groups. In addition Chelsea Station #488 has two of the four DSS lines of the Sumner/Callahan Tunnel Line Group.

The **Logan East Line Group** consists of DSS lines 486-198 and 486-199H. The line group supplies Logan Airport Stations #486 and distribution circuit 486-199H1. Upon the loss of the 486-198 line the remaining DSS line will exceed the long-term emergency capacity (LTE), based on 2002 peak loads. The distribution circuit 486-199H1 must be transferred to reduce the loading of 486-199H. Additional load relief can be obtained by using the internal tie lines between customer stations 308,592 and 486. The new supply line to Logan Airport "Terminal A" will provide additional relieve for the Line Group.

The **Logan West Line Group** consists of four DSS lines, 295-72, 308-54H, 308-197H and 592-70XYH. The line group supplies a portion of Logan Airport load, Stations# 308, 592 and customer Stations #271, 394 and 295. Both lines 308-54H1 and 592-70XYH have distribution circuits tapped off these lines. Upon the loss of any of the DSS lines, the remaining DSS lines will exceed the long-term emergency capacity (LTE), based on 2004-2008 peak load projections.

The **Sumner/Callahan Tunnel Line Group** consists of four DSS lines 224-87H, 262-53H, 218-80H and 218-188. DSS lines 224-87H and 262-53 H originate from Chelsea Sta #488 and supplies customer stations 224, 262, 394, 542 and MC 7,8,12 and PMH15005 in East Boston. The DSS lines 218-80H and 218-188 originate from Mystic Sta #250 and supply NSTAR Salem Street Station #30 in the North End section of the city of Boston and customer stations 218, 393, 539, 6, 572, 599 and 545 in Boston. The Chelsea lines 224-87H and 262-53H are part of a two-line supply and support each other. The two Boston lines 218-80H and 218-188 are part of a two-line supply and support each other. The Boston and Chelsea lines are connected by a looped line thru the Callahan Tunnel via Stations 393 and #394. Upon the loss of any of the DSS lines, the remaining DSS lines will not exceed the long-term emergency capacity (LTE), based on 2004-2008 peak load projections.

The following table provides the details on these line groups.

<b>DSS Line</b>	<b>% of Normal 2004</b>	<b>LTE - % Load at Risk 2004</b>	<b>MVA at Risk 2004</b>	<b>LTE - % Load at Risk 2008</b>	<b>MVA at Risk 2008</b>
486-198	50%	0%	0	0%	0
486- 199H	80%	0%	0	0%	0
295-72	37%	0%	0	0%	0
308- 54H	108%	7%	0.6	25%	2.5
308- 197H	89%	40%	2.5	55%	3.7
592-	75%	44%	3.6	57%	5.0

70XYH					
224-87H	45%	0%	0	0%	0
262-53H	35%	0%	0	0%	0

***Loading on Chelsea #445 and #488 DSS lines.***

### 14 kV Distribution Circuits

Two of the four distribution circuits fed from Chelsea Street #445 have adequate capacity. In 2004 445-H4, will reached or exceed 100% of its normal capacity with all lines in service. By 2006 another circuit 445-H2 is projected to exceed its normal capacity with all lines in service. In addition by 2007/2008 488-H1 and 488-H2 will heavy loaded and exceed their normal ratings for all lines in service. The table below shows the available capacity on the distribution circuits, respectively. There are no 4kV stations/circuits within this region.

14 kV Radial Line	% of Normal 2002	Projected % of Normal 2004	Projected % of Normal 2008
445-H1	64%	78%	86%
445-H2	79%	96%	106%
445-H3	66%	81%	90%
445-H4	83%	100%	111%
488-H1	96%	92%	102%
488-H2	96%	92%	101%

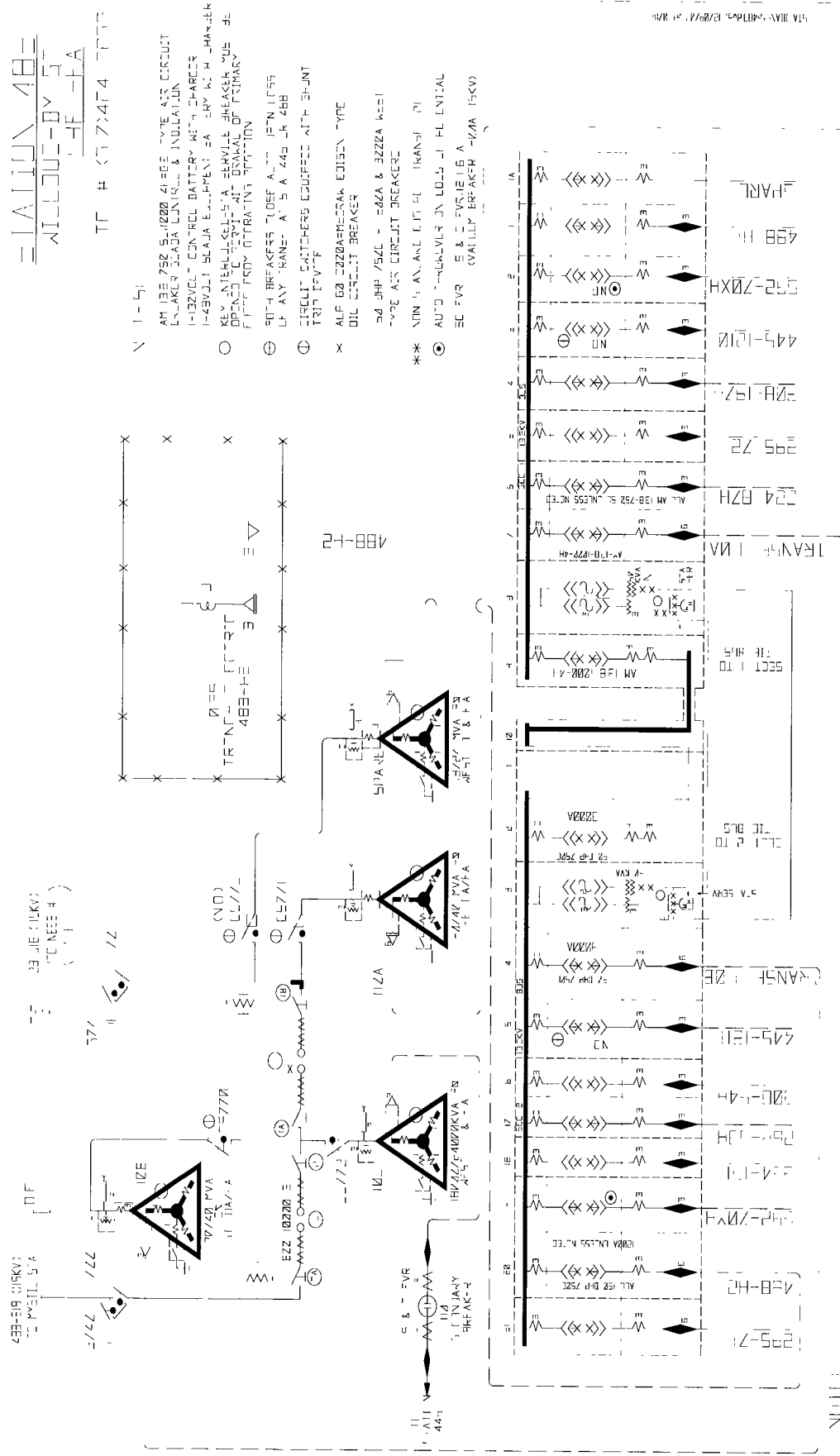
***Loading on the Chelsea and East Boston Distribution Circuits.***

### Proposed Integrated Plan

The suggested actions listed in the table below will address all of the capacity concerns in the region. Install and place into service a mobile 115/14kV transformer within 24 hours of a failure of one of the Chelsea Station #488 transformers. The proposed East Boston Substation will have a significant impact on the substation and distribution capacity in the Chelsea and East Boston supply region. The East Boston substation with a firm capacity of 75 MVA and the associated distribution infrastructure will be the foundation for the Chelsea and East Boston supply region capacity plans well beyond 2008. The new station will provide expanded distribution infrastructure into East Boston and relieve the heavy loading conditions on the distribution circuits and DSS lines supplied from Chelsea Stations #445 and #488.

Action	Year needed	Cost
⇒ New East Boston 115/14kV station; supplied by Mystic-East Boston and East Boston-K Street 115kV line.	2005	\$32 Million

***Recommended course of action for Chelsea-East Boston Region***



IF A TRANSFORMER IS OUT OF SERVICE AT CCA 445 OR 430 AND THE TIES ARE CLOSED, OPEN NEUTRAL OF ONE TRANSFORMER

DATE	DESCRIPTION	AMOUNT	INITIALS
5/21/72	PAID TO MRS. M. A. MARK-UP	100.00	MA
5/11/72	PAID TO MRS. M. A. MARK-UP	100.00	MA
4/27/72	PAID TO MRS. M. A. MARK-UP	100.00	MA
7/3/72	PAID TO MRS. M. A. MARK-UP	100.00	MA



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## ***2004 T&D OPERATING STUDY SOMERVILLE DISTRICT***

### **STATION #800 KENDALL (CELCO)**

Kendall Station #800 supplies the eastern section of the City of Cambridge. Kendall Station #800 total capacity is 92 MVA (CELT Rating). Station #800 firm capacity is 70 MVA. Kendall Station #800 is interconnected to Putnam Station #831 and Prospect Station #819. The subsequent support from these stations has nominally been determined to be 38 MVA. Kendall Station #800 load carrying capability is 130 MVA (Kendall total capacity + Prospect + Putnam support).

Kendall Station #800 consists of generation that is owned by Mirant Kendall LLC as follows:

	<b><u>Name Plate Rating</u></b>	<b><u>Voltage</u></b>	<b><u>CELT Rating</u></b>
Generator #1	18.8 MVA	13.8kV	16.5 MVA
Generator #2	25.0 MVA	13.8kV	22.0 MVA
Generator #3	25.6 MVA	13.8kV	22.5 MVA
Generator #4	219 MVA	18kV	N/A
Jet #1	25 MVA	13.8kV	16 MVA
Jet #2	25 MVA	13.8kV	15 MVA

### **Overload Ratings:**

Generating station, standard overload ratings do not apply.

### **Station Capabilities:**

Total Station Capacity (N)	Station Firm Capacity (LTE)	Intra Tie Transfer	Manual Transfer	Total LCC	Rating
92 MVA	70 MVA	38 MVA	0 MVA	108 MVA	CELT
119 MVA	94 MVA	38 MVA	0 MVA	132 MVA	Nameplate

### **2004 – 2008 Projected Load:**

2004	2005	2006	2007	2008
146 MVA	157 MVA	164 MVA	170 MVA	175 MVA

### **Switching Actions:**

None, the interconnection is always closed.

### **Summary of Concerns:**

1. Inadequate supply capabilities for the City of Cambridge load beyond 2003 due to the projected increase in customer load in the Kendall Square and MIT



areas. The forecasted load growth in this area is based on the fact that this vicinity has one of the last available open spaces in Cambridge for residential and commercial property development and the city has extensive and aggressive plans for its development.

2. In addition, inadequate supply capability for the loss of the capacity of the three (3) existing steam generators currently owned by Mirant at Kendall Station # 800 that are connected to and supporting the existing Cambridge 13.8kV system but are planned to have their output stepped up and directed to the 115kV transmission system. Further, in late 2002 Mirant reconfigured the steam supply to the existing steam generation at Kendall Station #800. The current operation provides steam service to these existing units from a heat recovery steam generator driven by a new Combustion Turbine (CT) exhaust allowing a single outage event (i.e. loss of the CT) to cause loss of all three 13.8 kV steam generating units at Kendall Station #800. This method of operation will result in reducing the firm capacity to the rating of the jets.

With significant development projects during 2004 – 2008, the Kendall supply region is projected to experience load growth approaching 4% annually, the need for additional supply is vital. Compounding the load growth issue is the diversion of 13.8kV supply from generation to the 115kV system.

### **Distribution Systems:**

#### **DSS Lines**

Kendall Station #800 DSS Lines show no immediate capacity concerns, since the addition of circuits 13-29 and 13-30 were added to relieve other lines and circuits. The new station will supply any new load.

<b>DSS Lines</b>	<b>% of Normal 2004</b>	<b>LTE - % Load at Risk 2004</b>	<b>Load at Risk 2004</b>	<b>LTE - % Load at Risk 2008</b>	<b>Load at Risk 2008</b>
13-13	43%	0	0	0	0
13-16	88%	0	0	0	0
13-17	79%	0	0	0	0
13-18	41%	0	0	0	0
13-22	40%	0	0	0	0
13-26	45%	0	0	0	0
13-28	87%	0	0	0	0
13-29	75%	0	0	0	0
13-30	91%	0	0	0	0
13-33	65%	0	0	0	0
13-43	73%	0	0	0	0
13-44	40%	0	0	0	0
13-45	96%	0	0	0	0
13-49	60%	0	0	0	0
13-51	60%	0	0	0	0
13-52	69%	0	0	0	0

13-53	47%	0	0	0	0
13-54	57%	0	0	0	0
13-55	5%	0	0	0	0
13-59	79%	0	0	0	0
13-64	49%	0	0	0	0
13-65	65%	0	0	0	0
13-67	88%	0	0	0	0
13-86	86%	0	0	0	0
13-101	59%	0	0	0	0

#### 4kV Substations

Kendall Station #800 feeds two 4kV Stations and shares the supply to two other with Prospect #819. The projected loading on the 4kV Stations is as follows:

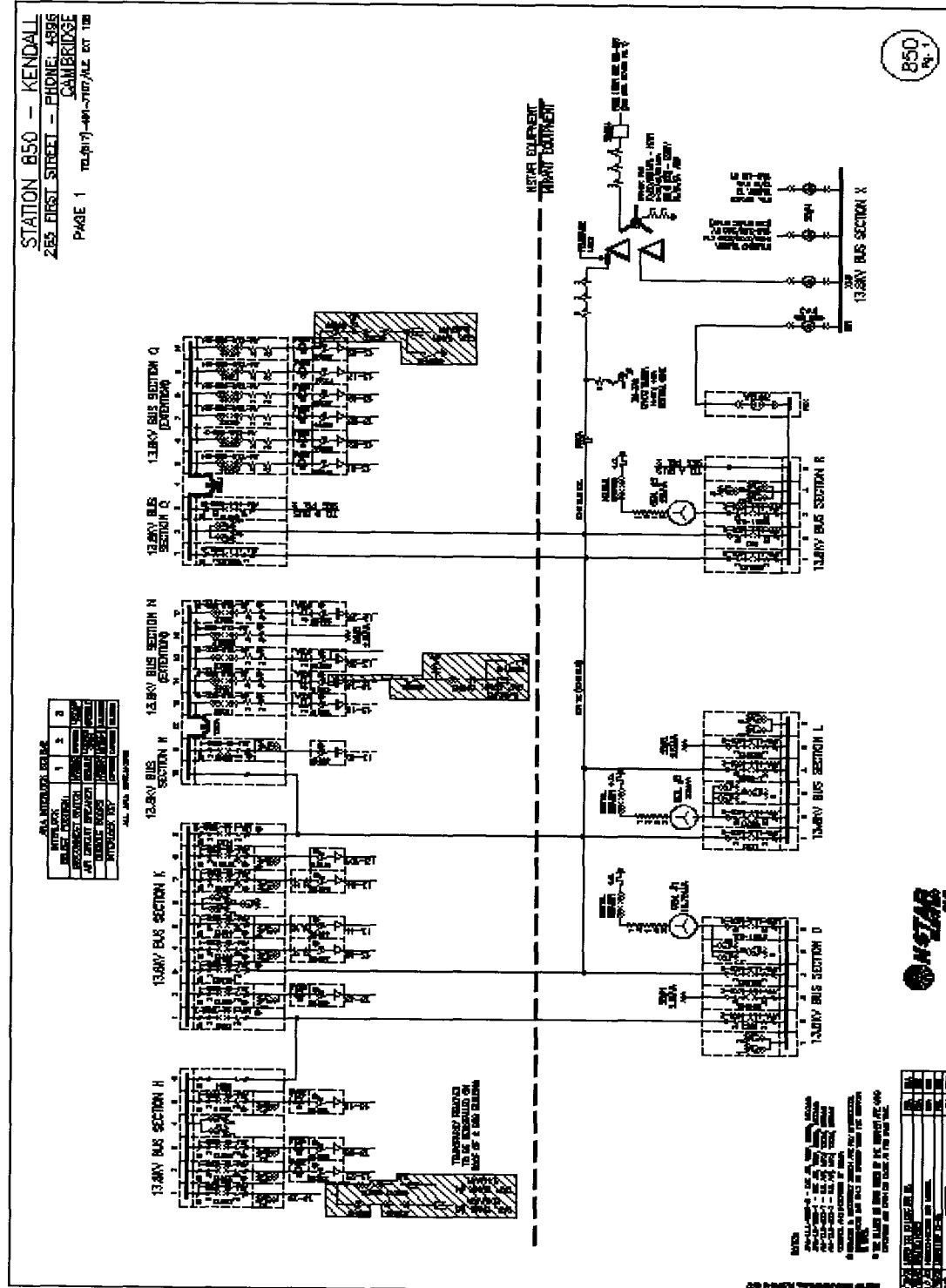
4kV Station	2002 Peak (MVA)	LTE Capacity (MVA)	2004 Projected (MVA)	2008 Projected (MVA)
CHARLES #811	1.6	6.0	1.6	1.7
POTTER #813	3.6	6.0	3.7	3.9
OTIS #812	3.7	4.5	3.8	4.0
HAMPSHIRE #814	7.1	9.0	7.3	7.8

#### Proposed Integrated Plan:

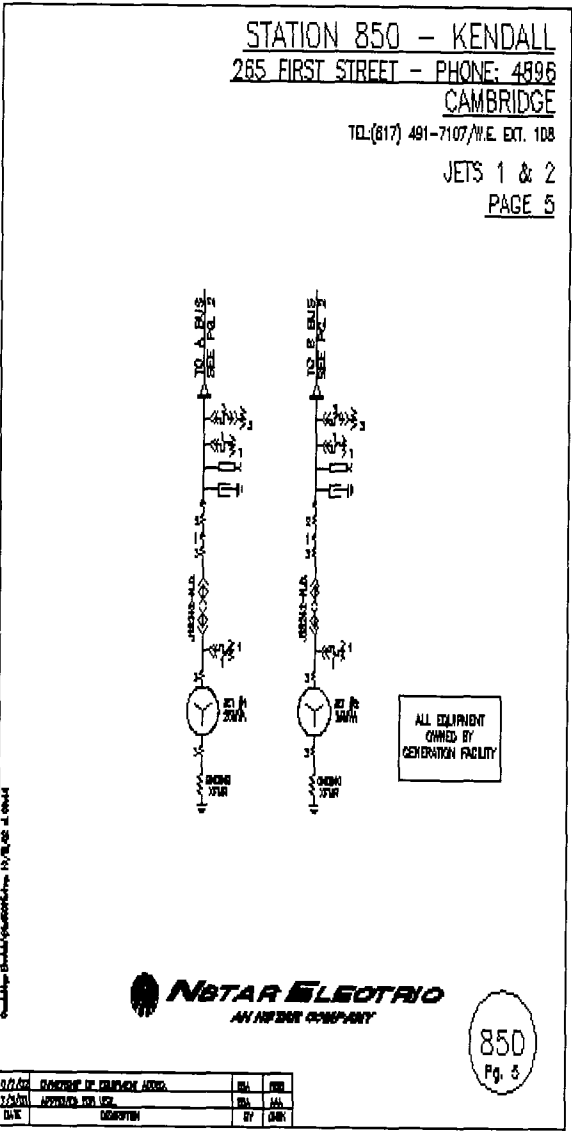
The new East Cambridge 115/14 kV substation is part of an integrated long-term solution, which will provide the necessary capacity additions needed to meet the area's new load requirements as well as ensure the reliability of service of this area. The development of the new East Cambridge 115/14 kV substation will support the rerouting of the steam generation power to 115kV system by transferring most of the load presently supplied from Kendall generators to East Cambridge Station, thereby addressing a potentially significant reliability concern. The new East Cambridge 115/14 kV station has capacity that would provide a measure of load relief of Putnam Avenue and Prospect Street Stations, #831 and 819, respectively.

#### Action

	Year needed	Cost
⇒ Engineer, design, and construct a bulk substation in the East Cambridge area to relieve the existing infrastructure from supporting extra load due to growth and the re-direction of 13.8kV generator supply to 115kV transmission system.	2004	\$25M







## ***2004 T&D OPERATING STUDY SOMERVILLE DISTRICT***

### **STATION #819 PROSPECT (CELCO)**

Prospect Station #819 supplies the north central sections of the City of Cambridge.  
Prospect Station #819 total capacity is 85 MVA.

Four bi-furcated 14kV cables from Somerville Station #402 supply Prospect Street Station #819. NSTAR employs emergency summer rating (cyclic capability) of 28 MVA for each bi-furcated cable. For the loss of a bifurcated cable Prospect Station #819 will have a firm capacity of 84 MVA. Prospect Station #819 is interconnected to Putnam Station #831 and Kendall Station #800. The subsequent support from these stations has nominally been determined to be 38 MVA. Prospect Station #819 load carrying capability is 122 MVA.

### **Overload Ratings:**

See LTE Rating below, there is no transformation at Prospect Street Station #819.

### **Station Capabilities:**

Total Station Capacity (N)	Station Firm Capacity (LTE)	Intra Tie Transfer	Manual Transfer	Total LCC
85 MVA	84 MVA (A)	38 MVA	0 MVA	122 MVA

Note A: Emergency capability for three bifurcated cables between Somerville Station #402 and Prospect Station #819.

### **2004 – 2008 Projected Load:**

2004	2005	2006	2007	2008
78 MVA	79 MVA	79 MVA	81 MVA	82 MVA

### **Switching Actions:**

None, the interconnection is always closed.

### **Summary of Concerns:**

During the 2004-2008 time period there are no concerns within the Prospect Street supply area.

The Prospect Supply region is projected to experience modest load growth, approximately 1.9% annual load growth. As a result of this small load growth based on load projections, starting in the summer of 2004 to 2008 for a single-contingency outage will not exceed the load carrying capability of the Prospect Station #819.

**Distribution Systems:****DSS Lines**

Prospect Station #819 DSS Lines and Distribution Circuits show no immediate capacity concerns, since load was transferred off the station and an old line redirected to a growing but existing load and circuit 13-109 was upgraded.

<b>DSS Lines</b>	<b>% of Normal 2004</b>	<b>LTE - % Load at Risk 2004</b>	<b>Load at Risk 2004</b>	<b>LTE - % Load at Risk 2008</b>	<b>Load at Risk 2008</b>
13-05	45%	0	0	0	0
13-08	40%	0	0	0	0
13-09	29%	0	0	0	0
13-10	91%	0	0	0	0
13-19	27%	0	0	0	0
13-27	60%	0	0	0	0
13-41	49%	0	0	0	0
13-42	22%	0	0	0	0
13-48	18%	0	0	0	0
13-58	41%	0	0	0	0
13-62	61%	0	0	0	0
13-98	28%	0	0	0	0
13-102	61%	0	0	0	0
13-109	92%	0	0	0	0

**Distribution Circuits**

<b>14 kV Radial Line</b>	<b>Summer Normal Rating in Amps</b>	<b>Projected % of Normal 2004</b>	<b>Projected % of Normal 2008</b>
13-06	285	86%	93%
13-31	245	92%	99%
13-57	285	75%	81%
13-60	245	81%	87%
13-73	455	10%	11%
13-74	455	10%	11%

**4kV Substations**

Prospect Station #819 feeds one 4kV Substations and shares the supply to six others as follows: three with Alewife #828, one with Putnam #831, and two with Kendall #800.

The projected loading on the 4kV Substations is as follows:

<b>4kV Station</b>	<b>2002 Peak (MVA)</b>	<b>LTE Capacity (MVA)</b>	<b>2004 Projected (MVA)</b>	<b>2008 Projected (MVA)</b>
AMORY #820	7.5	9.0	7.7	8.2
MELLEN #822	5.3	6.0	5.5	5.8

HEALEY #823	6.3	9.0	6.5	6.9
WALDEN #824	4.2	9.0	4.3	4.6
CAMBRIDGE #821	4.1	6.0	4.2	4.5
OTIS #812	3.7	4.5	3.8	4.0
HAMPSHIRE #814	7.1	9.0	7.3	7.8

**Proposed Integrated Plan:**

Based on 2004-2008 load projections there are no actions required to supply the increased customer load within the Prospect supply region during the 2004-2008 time period.

**Action**

**Year  
needed    Cost**

⇒ None required at this present time.



## ***2004 T&D OPERATING STUDY SOMERVILLE DISTRICT***

### **STATION #828 ALEWIFE (CELCO)**

Alewife Station #828 supplies the western section of the City of Cambridge and the Municipal for the town of Belmont. In the summer of 2002 Alewife Station load peak was 108 MVA.

Alewife Station #828 consist of the following transformers:

Transformer T1:	McGraw-Edison 30/40/50 [56] MVA 117.5/1.4 kV
Transformer T2:	McGraw-Edison 30/40/50 [56] MVA 117.5/1.4 kV
Transformer T4:	McGraw-Edison 30/40/50 [56] MVA 117.5/1.4 kV

Alewife Station #828 total capacity is 168 MVA. NSTAR employs emergency summer rating (cyclic capability) of 64 MVA for each transformer. Station #828 firm capacity is 128 MVA. There is no transfer switching capability to adjacent stations. Alewife's load carrying capability (i.e. firm capacity + transfer switching) is 128 MVA.

### **Overload Ratings:**

Transformer	Nameplate	12 hour LTE, 90F Ambient	12 hour LTE, 110F Ambient
T1	30/40/50 [56] MVA	71 MVA	66 MVA
T2	30/40/50 [56] MVA	70 MVA	64 MVA
T4	30/40/50 [56] MVA	70 MVA	64 MVA

### **Station Capabilities:**

Total Station Capacity (N)	Station Firm Capacity (LTE)	RADSEC Transfer	Manual Transfer	Total LCC
168 MVA	128 MVA	0 MVA	0 MVA	128 MVA

### **2004 – 2008 Projected Load:**

2004	2005	2006	2007	2008
111 MVA	111 MVA	112 MVA	114 MVA	115 MVA

### **Switching Actions:**

#### **Loss of Transformer #T1:**

**Open:** Circuit Breakers #3 and #4 at Station 509 N. Cambridge  
Main 13.8kV Circuit Breaker #26B72  
Disconnect Switch #T732 at Station 509 N. Cambridge  
**Close:** Circuit Breakers #3 and #4 at Station 509 N. Cambridge  
13.8kV Bus Ties Operated Normally Closed

#### **Loss of Transformer #T2:**

**Open:** Circuit Breakers #6 and #7 at Station 509 N. Cambridge  
Main 13.8kV Circuit Breaker #26B82  
Disconnect Switch #T734 at Station 509 N. Cambridge  
**Close:** Circuit Breakers #6 and #7 at Station 509 N. Cambridge  
13.8kV Bus Ties Operated Normally Closed

Loss of Transformer #T4:

**Open:** Circuit Breakers #1 and #2 at Station 509 N. Cambridge  
Main 13.8kV Circuit Breaker #26B102  
Disconnect Switch #T733 at Station 509 N. Cambridge  
**Close:** Circuit Breakers #1 and #2 at Station 509 N. Cambridge  
13.8kV Bus Ties Operated Normally Closed

**Summary of Concerns:**

1. Inadequate 4kV transformer capacity at Stations #827 & #830 (2004)

The Alewife Supply region is projected to experience modest load growth, approximately 0.2% annual load growth. As a result of this small load growth based on load projections, during the summer of 2004 to 2008 for a single-contingency outage of any of the transformers, Alewife Station #828 will not exceed the load carrying capability.

**Distribution Systems:**

**DSS Lines**

Alewife #828 Substation DSS Lines and Distribution Circuits show no immediate capacity concerns, since circuits 13-25, and 13-63 were added to relieve other lines and circuits and 13-38 was upgraded.

DSS Line	% of Normal 2004	LTE - % Load at Risk 2004	Load at Risk 2004	LTE - % Load at Risk 2008	Load at Risk 2008
13-21	95%	0	0	0	0
13-38	85%	0	0	0	0
13-39	37%	0	0	0	0
13-63	71%	0	0	0	0
13-77	60%	0	0	0	0
13-78	60%	0	0	0	0
13-79	84%	0	0	0	0
13-80	0%	0	0	0	0
13-81	53%	0	0	0	0
13-84	79%	0	0	0	0
13-103	55%	0	0	0	0
13-104	65%	0	0	0	0
13-105	36%	0	0	0	0
13-106	67%	0	0	0	0

14 kV Radial Line	Summer Normal Rating in Amps	Projected % of Normal 2004	Projected % of Normal 2008
13-25	350	89%	89%
13-69	285	86%	87%
13-70	285	83%	83%
13-71	350	84%	85%
13-72	455	55%	55%
13-75	350	16%	16%
13-76	430	13%	13%
13-82	350	0%	0%
13-83	350	1%	1%

#### 4kV Substations

Alewife Station #828 feeds five 4kV Stations and shares the supply to three other 4kV Stations with Prospect #819. The projected loading on the 4kV Stations is as follows:

The 4kV Stations of Concord #827 and Aberdeen #830 will exceed their LTE ratings for the peak load in 2004.

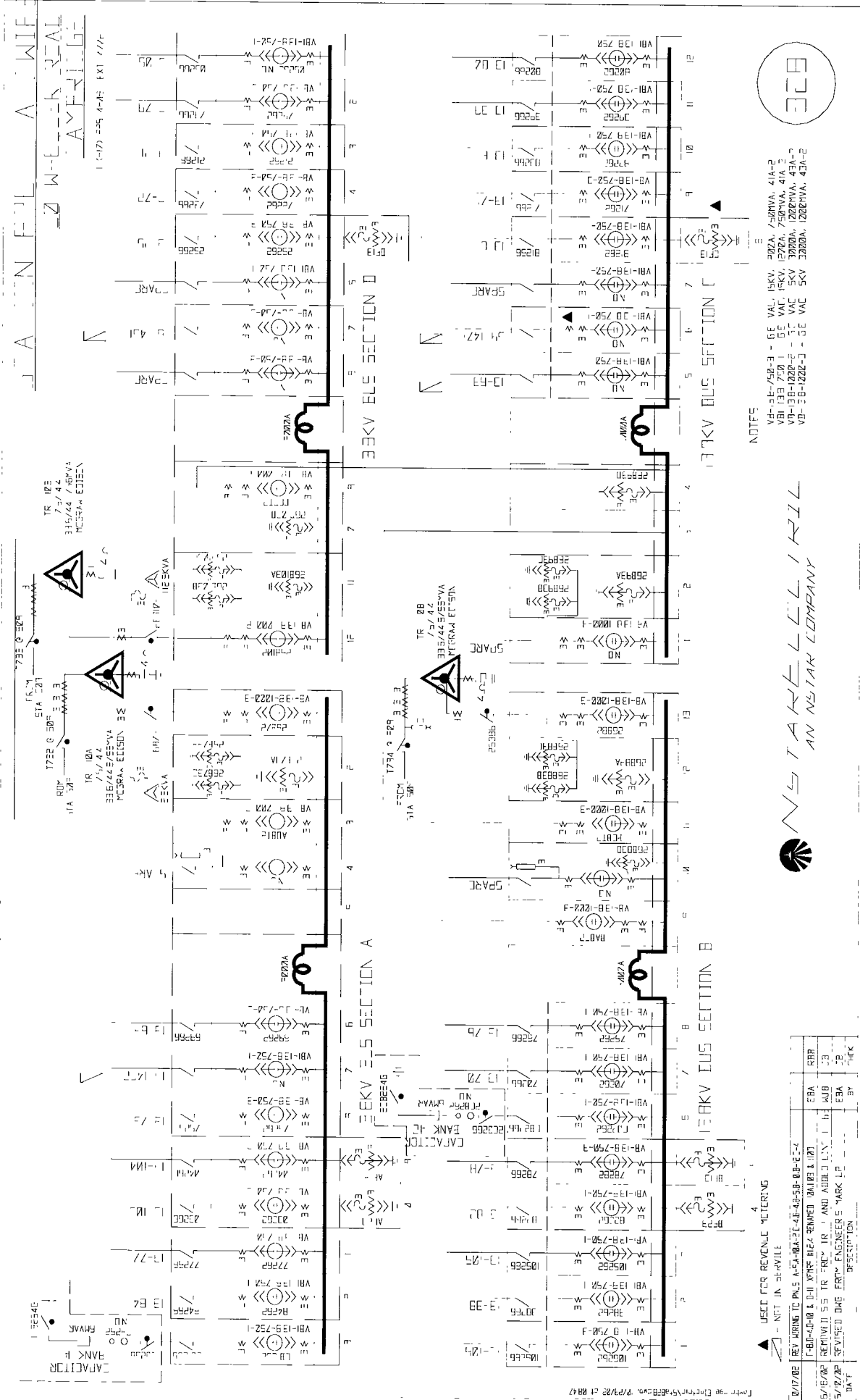
4kV Station	2002 Peak (MVA)	LTE Capacity (MVA)	2004 Projected (MVA)	2008 Projected (MVA)
SHERMAN #825	5.8	9.0	6.0	6.4
EDMUNDS #826	3.6	4.5	3.7	3.9
CONCORD #827	6.0	6.0	6.3	7.0
SMITH PL #829	3.4	5.0	3.5	3.7
ABERDEEN #830	3.6	3.6	3.7	4.0
MELLEN #822	5.3	6.0	5.5	5.8
HEALEY #823	6.3	9.0	6.5	6.9
WALDEN #824	4.2	9.0	4.3	4.6

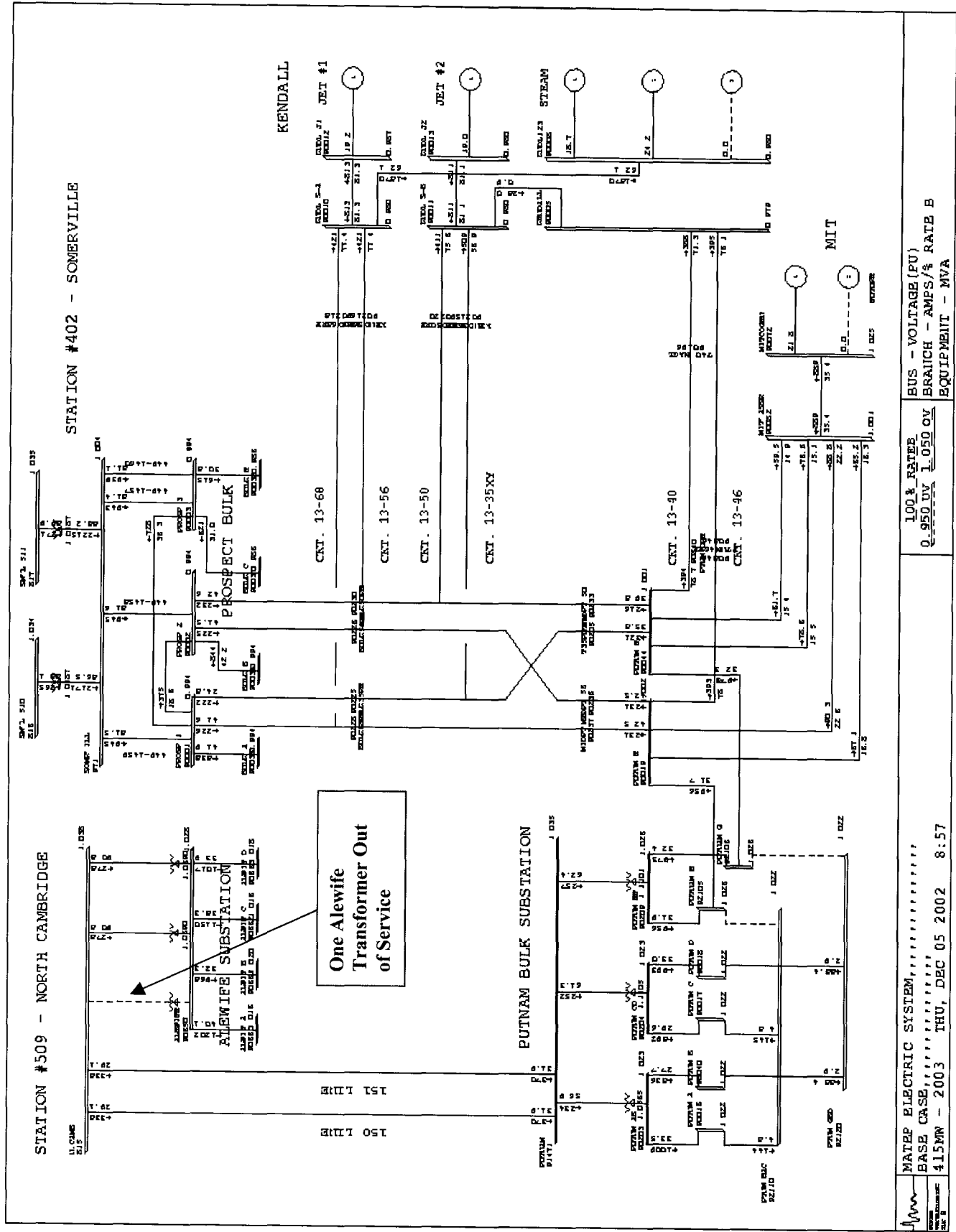
#### Proposed Integrated Plan:

The action plan in the table below will address the concerns within the Alewife Supply area. The focus of the plan is to increase the transformer supply at several 4kV stations to address the projected load growth at these stations. The 4kV system will not be expanded with new 4 kV circuits, the additional transformer capacity will support the modest load growth within the 4kV areas.

Action	Year needed	Cost
⇒ Install fans at Concord to increase capacity and replace the 3MVA transformer at Aberdeen with a 5MVA	2004	\$40k







MATEP ELECTRIC SYSTEM

BASE CASE

415MW - 2003 THU, DEC 05 2002 8:57

## ***2004 T&D OPERATING STUDY SOMERVILLE DISTRICT***

### **STATION #831 PUTNAM (CELCO)**

Putnam Station #831 supplies the south central section of the City of Cambridge. Putnam Station is interconnected to Kendall Station #800 and Prospect Station #819. In the summer of 2002 Putnam Station load peak was 137 MVA.

Putnam Station #831 consist of the following transformers:

Transformer A: General Electric 37.5/50/62.5 [70] MVA 117.5 / 14.4 kV

Transformer B: General Electric 37.5/50/62.5 [70] MVA 117.5 / 14.4 kV

Transformer C: General Electric 37.5/50/62.5 [70] MVA 117.5 / 14.4 kV

Putnam Station #831 total capacity is 210 MVA. NSTAR employs emergency summer rating (cyclic capability) of 81 MVA for each transformer. Station #831 firm capacity is 162 MVA. There is no transfer switching capability to adjacent stations. Putnam's load carrying capability (i.e. firm capacity + transfer switching) is 162 MVA.

### **Overload Ratings:**

Transformer	Nameplate	12 hour LTE, 90F Ambient	12 hour LTE, 110F Ambient
A	37.5/50/70 MVA	86 MVA	81 MVA
B	37.5/50/70 MVA	86 MVA	81 MVA
C	37.5/50/70 MVA	86 MVA	81 MVA

### **Station Capabilities:**

Total Station Capacity (N)	Station Firm Capacity (LTE)	Intra Tie Transfer	Manual Transfer	Total LCC
210 MVA	162 MVA	0 MVA	0 MVA	162 MVA

### **2004 – 2008 Projected Load:**

2004	2005	2006	2007	2008
115 MVA	120 MVA	124 MVA	130 MVA	134 MVA

### **Switching Actions:**

#### **Loss of Transformer A:**

- Open:** Circuit Breakers #1 and #2  
 13.8 kV Circuit Breakers 1AHT2 and 1BGT2  
 Disconnect Switch #115A  
**Close:** Circuit Breakers #1 and #2

Transformers A and B normally operated in parallel, no 13.8kV tie breakers need to be closed; to engage Transformer C - Close 13.8kV Tie Breakers EH3T2 to tie E bus to H bus and FG3T2 to tie F bus to G bus.

Loss of Transformer B:

**Open:** Circuit Breakers #2 and #3

13.8 kV Circuit Breakers 2CHT2 and 2DGT2

Disconnect Switch #115B

**Close:** Circuit Breakers #2 and #3

Transformers A and B normally operated in parallel, no 13.8kV tie breakers need to be closed; to engage Transformer C - Close 13.8kV Tie Breakers EH3T2 to tie E bus to H bus and FG3T2 to tie F bus to G bus.

Loss of Transformer C:

**Open:** Circuit Breakers #4 and #5

13.8 kV Circuit Breakers 3EHT2 and 3FGT2

Disconnect Switch #115C

**Close:** Circuit Breakers #4 and #5

Close 13.8kV Tie Breakers EH3T2 to tie E bus to H bus and FG3T2 to tie F bus to G bus.

**Summary of Concerns:**

1. DSS lines 13-02, 13-12, and 13-61 are at or nearing their normal rating and will be over in 2004.
2. Inadequate 4kV transformer capacity at Station #817. (2004)

The Putnam Supply region is projected to experience modest load growth, approximately 1.5% annual load growth. As a result of this small load growth based on load projections, during the summer of 2004 to 2008 for a single-contingency outage of any of the transformers, Putnam Station #831 will not exceed the load carrying capability.

**Distribution Systems:**

**DSS Lines**

Putnam #831 Substation DSS Lines and Distribution Circuits show no immediate capacity concerns, since circuits 13-7, and 13-47 were added to relieve other lines and circuits. The 13.8kV feeders associated with Station #817 will require an addition and/or upgrade in order to carry the increased capacity of the transformers.

DSS Line	% of Normal 2004	LTE - % Load at Risk 2004	Load at Risk 2004	LTE - % Load at Risk 2008	Load at Risk 2008
13-01	35%	0	0	0	0
13-02	98%	0	0	0	0
13-03	82%	0	0	0	0
13-04	55%	0	0	0	0
13-07	83%	0	0	0	0



13-11	43%	0	0	0	0
13-12	99%	0	0	0	0
13-14	79%	0	0	0	0
13-24	61%	0	0	0	0
13-32	49%	0	0	0	0
13-34	46%	0	0	0	0
13-37	59%	0	0	0	0
13-47	59%	0	0	0	0
13-61	100%	0	0	0	0
13-66	23%	0	0	0	0
13-87	79%	0	0	0	0
13-88	82%	0	0	0	0
13-94	63%	0	0	0	0
13-97	21%	0	0	0	0

**Distribution Circuits**

14 kV Radial Line	Summer Normal Rating in Amps	Projected % of Normal 2004	Projected % of Normal 2008
13-20	445	46%	48%
13-23	285	78%	83%
13-36	390	68%	72%
13-110	455	76%	81%
13-111	245	68%	73%
13-112	245	0%	0%
13-113	245	64%	68%
13-107	285	46%	49%
13-108	285	46%	49%
13-91	245	25%	26%
13-93	245	29%	31%
13-95	245	0%	0%
13-96	245	0%	0%

**4kV Substations**

Putnam Station #831 feeds three 4kV Substations and shares the supply to one other 4kV Station with Prospect #819. The projected loading on the 4kV Substations is as follows:

The station Putnam #817 is at its LTE ratings for the peak load.

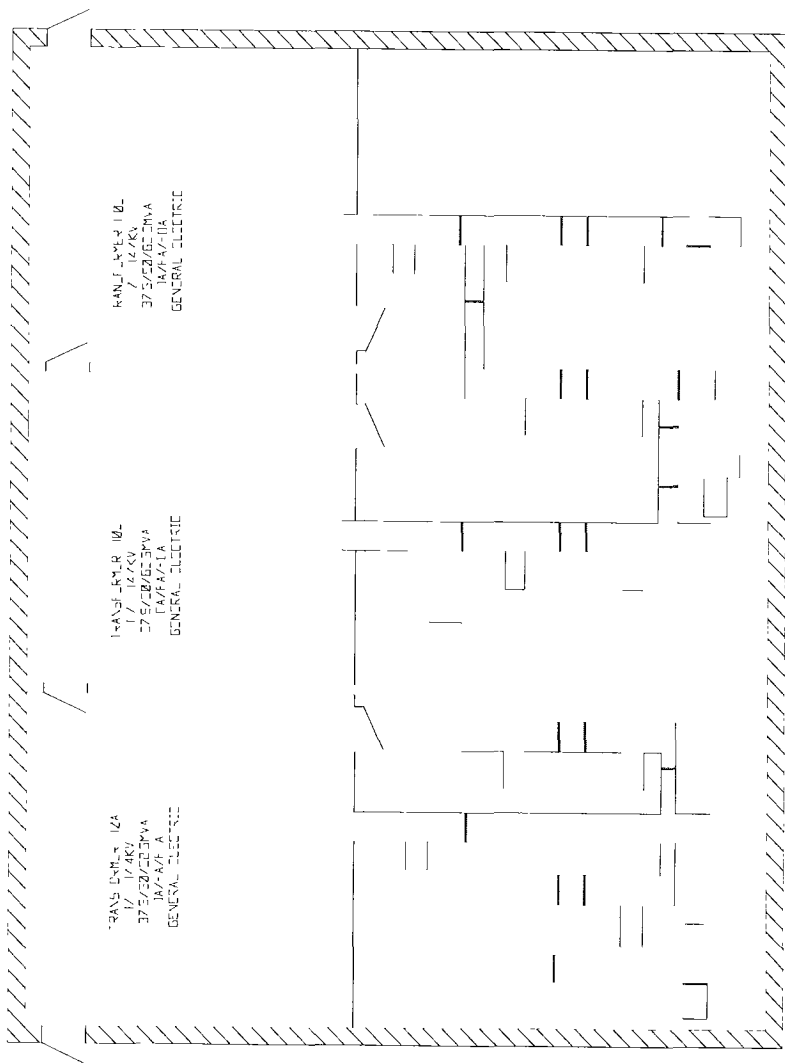
4kV Station	2002 Peak (MVA)	LTE Capacity (MVA)	2004 Projected (MVA)	2008 Projected (MVA)
PACIFIC #815	1.5	3.6	1.5	1.6
VASSAR #816	5.9	6.7	6.1	6.4
PUTNAM 1 & 2 #817	11.0	9.0	11.3	12.0
CAMBRIDGE #821	4.1	6.0	4.2	4.5

**Proposed Integrated Plan:**

The action plan in the table below will address the concerns within the Putnam Supply area. The focus of the plan is to increase the transformer supply at several 4kV stations to address the projected

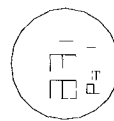
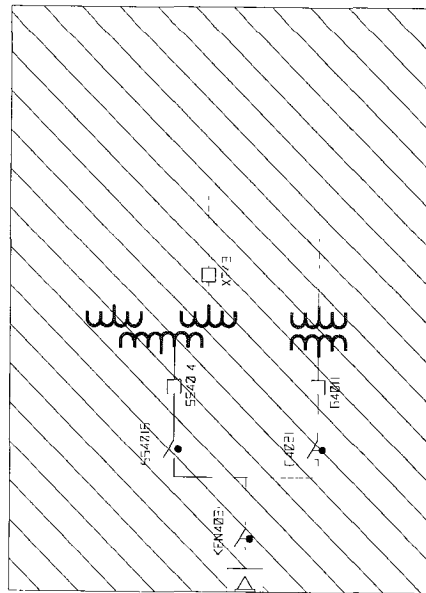
load growth at these stations. The 4kV system will not be expanded with new 4 kV circuits, the additional transformer capacity will support the modest load growth within the 4kV areas.

<b>Action</b>	<b>Year needed</b>	<b>Cost</b>
⇒ Reconductor part of 13-02, and 13-12.	2004	
⇒ Install fans at Putnam, and add 13.8kV feeder and necessary breakers	2004	\$315k



4 TRANSFORMER 10A & 10.3 LIT OPERATES IN PARALLEL  
TRANSFORMER 10T OPERATES INDEPENDENT

////



VEI-13-7-74-1 - GE VAL. 1-KV 100MA 750MVA  
VB-4-7-750 - GE VAL. 5KV 200A 150MVA  
VB-3-4-1000 - GE VAL. 5KV 100MA 100MVA

THE REACTOR BANK BREAKERS (13/7-30, 13/7-32,  
4-32/30 AND 4-32/32) INTERLOCKED WITH REACTOR BREAKERS  
AND ARE TO PREVENT "OVERCURRENT" OPERATION

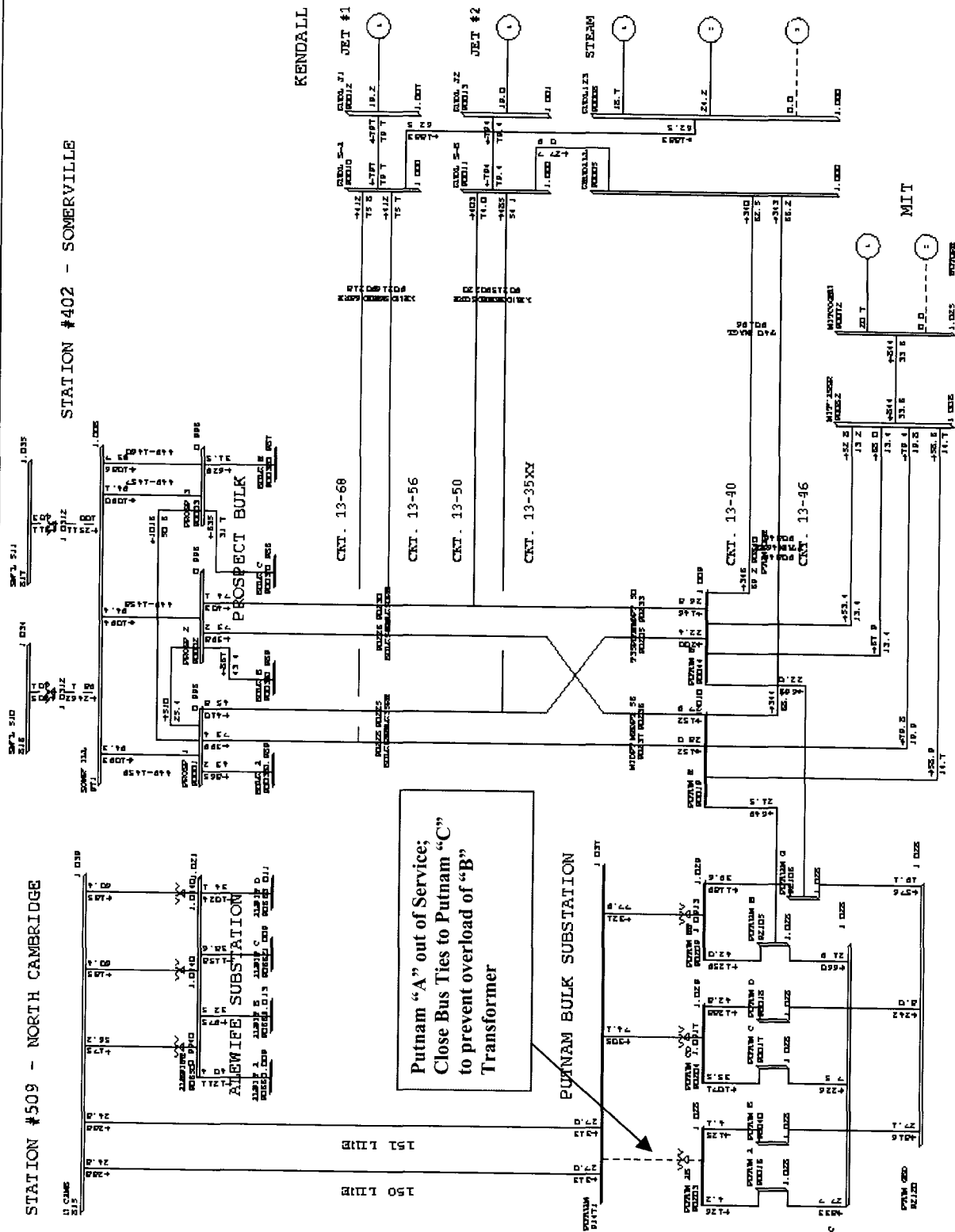
☐ - NOT IN SERVICE

EEA	RBE
WJE	IF
CBA	JB
CBA	REE

7/7/82 REVISED PER ENGINEER'S MARK L<sup>0</sup>  
7/19/82 ADDED LINE "5-4" TO SECTION A4  
5/12/82 REVISED DWS FROM ENGINEER'S MARK UP  
7/2/82 APPROVED FOR USE

19 520

STATION #402 - SOMERVILLE



## Putnam "A" out of Service; Close Bus Ties to Putnam "C" to prevent overload of "B" Transformer

~~PUTNAM BULK SUBSTATION~~

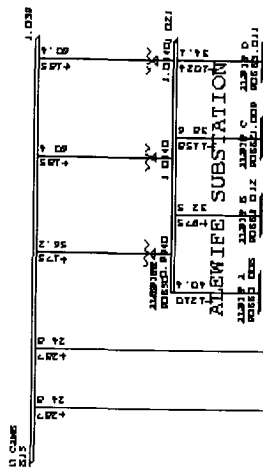
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MATEP ELECTRIC SYSTEM,,,,,,,,,,,,,
BASE CASE,,,,,,,,,,,,,
415MW - 2003 THU, DEC 05 2002 8:

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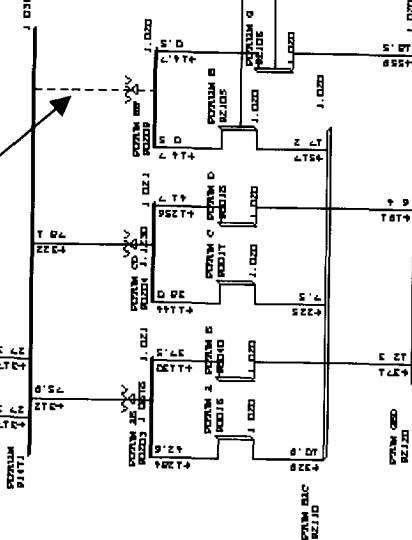
BUS - VOLTAGE (PU)  
BRAUCH - AMPS/% RATE B  
EQUIPMENT - MVA

STATION #509 - NORTH CAMBRIDGE

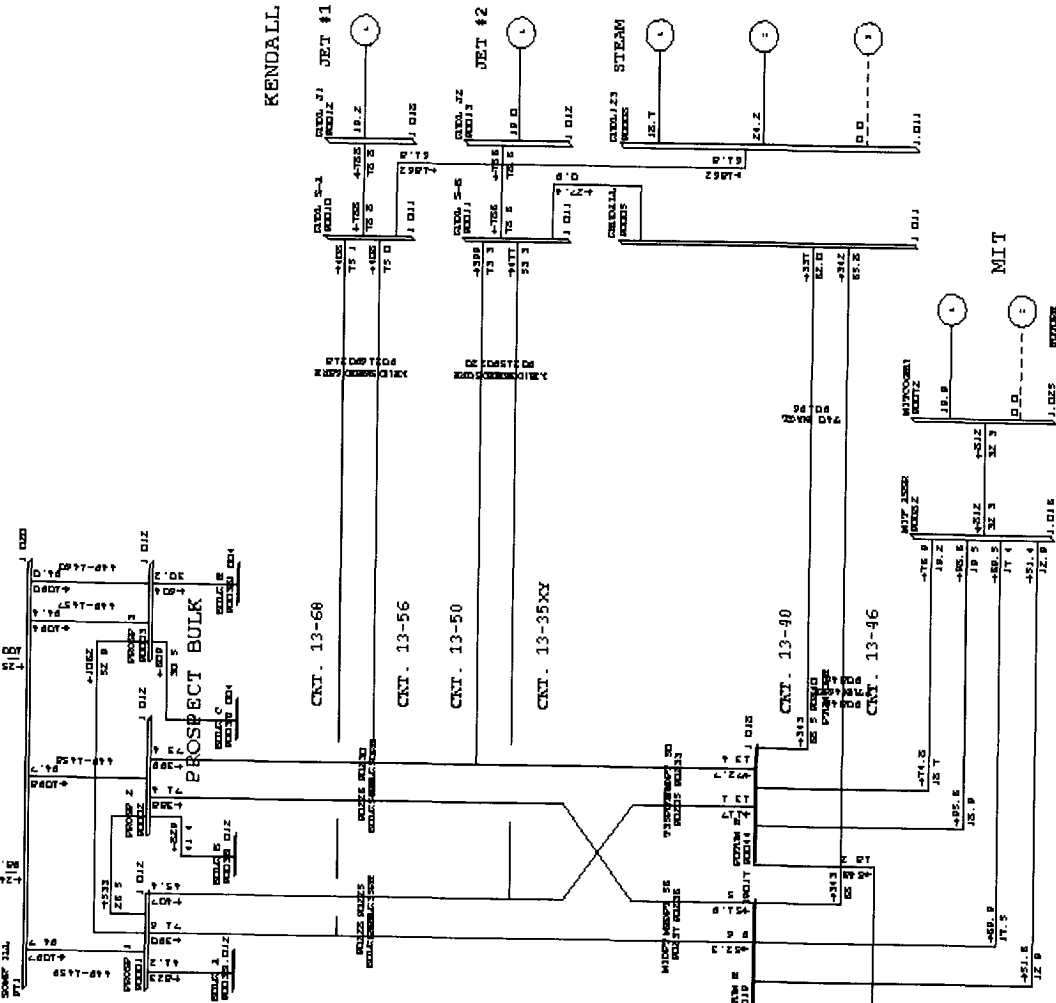


Putnam "C" Transformer  
Out of Service; close ties to  
"A" and "C" transformer  
busses to prevent overload  
of 13.8kV DSS System to  
Kendall

PUTNAM BULK SUBSTATION



STATION #402 - SOMERVILLE



MATEP ELECTRIC SYSTEM  
BASE CASE  
415MW - 2003 THU, DEC 05 2002 8:40

100% RATE  
0.950 DV 1.050 OV  
BUS - VOLTAGE (PU)  
BRANCH - AMPS/% RATE B  
EQUIPMENT - MVA

